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The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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The Registered Office and Laboratories of the B.C.I.R.A. are:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone: Central 1885. Telegrams: CIRA
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk
Telephone: 332

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The Bend Test

A lengthy Paper has just been presented by Mr. L. W. Schuster to the Institution of Mechanical Engineers on the bend test as a guide to ductility. The conclusions point to the necessity for revising specifications for bend tests where they are used. For ordinary steel, bend and tensile tests can be correlated with sufficient accuracy for commercial testing. It is also shown that the relation of width to thickness of the specimen is an important factor. For the same severity of bend test, either the width of specimen must be related to the thickness, or, for a constant width of specimen the former on which the bend test is made, and which governs the radius of the bend, must be varied. It is also established that there is no necessity to continue a bend test after 120 deg. is reached. These are some of the more important conclusions.

Now, while the actual angle of bend obtained on an ordinary transverse test on grey iron is slight, the bend test is standard for malleable iron. In this connection we may recall the points established in Mr. J. G. Pearce's recent Paper to the Iron and Steel Institute. When a piece of cast iron is bent, some of the distortion is purely elastic and some is plastic. The former part is lost as the bar springs back after the load is removed, while the latter causes part of the bend to be retained. In a grey iron the elastic part is about three-quarters of the total, although in a hard iron it may be as much as over 90 per cent. and in a ductile iron as little as 20 per cent. The measure of ductility is shown by the plastic distortion or permanent set. It was shown that in cast iron the elastic and plastic distortion occur together even at low loads. Now a malleable cast iron shows a similar result, and the elastic deflection was in a given case only about 10 per cent. of the total deflection at fracture. The malleable process can therefore be regarded as a means of conferring power to undergo plastic distortion before fracture. The elastic deflections do not differ a great deal as between these different types. The difference between grey and malleable iron under bending is of degree and not of kind. The steels undergo very little plastic distortion before the elastic limit is reached, but even here there is a slight plastic distortion, at low loads, accompanying the usual elastic distortion. It would therefore appear possible to apply the conclusions derived by Mr. Schuster for steels to cast steels and malleable irons in so far as they require to be specified by bending tests.

Symposiums

This word in engineering circles admits of two interpretations, the one having reference to a few important Papers discussed by the representatives of a large number of societies, and the other a large number of Papers representing the latest thought on every phase of one particular development. We are not particularly enamoured of either type of symposium on the following grounds. In the case of the few Papers put forward with the object of inducing people from a large audience to contribute supplementary knowledge by discussion, we find that only the accomplished orator and not necessarily those of mature experience take part. This is perhaps due to stage fright, or maybe a fear of being ruled out owing to wandering away from the subject matter of the Papers submitted. As to the second type, it appears to us as being something exotic and unnatural. With a plethora of Papers on any one subject there is bound to be a good deal of duplication and the participants are likely to suffer from a type of technical indigestion. Unquestionably a mass of useful information is brought forward, and afterwards is available for all and sundry to study; but if any expert cared to publish a text-book compiled from such information, then at least the student would have something reasonably valuable.

There is, however, another type of symposium, not usually graced by such a high-sounding term, which is a feature of the annual meetings of the Institute of British Foundrymen. Hereat using the nomenclature of a hyphenated session, members segregate themselves to discuss a small collection of Papers dealing with grey iron, nonferrous alloys, steel castings or other foundry subjects, where an intimate atmosphere prevails and discussion is usually spontaneous and animated. We often wonder why departure from the orthodox is suggested, as there is no reason to believe that superior methods for advancing technology have been evolved. There is a process of wide engineering and metallurgical interest which has been the subject of Papers and discussions under the ægis of various technical societies. Little interest was aroused and the discussions were desultory until a lecturer of the enthusiastic type lectured before a comparatively small audience of foundrymen. The discussion was more enlightening than in any of the previous lectures, because of the intimate atmosphere that prevailed. This is then the main ground upon which we criticise the well stage-managed, mammoth symposiums, as all intimate discussion is ruled out *per se*, and practical participation in general is confined to those who can be relied upon to open a discussion on the most diverse subjects only remotely connected with their daily work.

XUM

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Earliest Grey-Iron Casting

To the Editor of The Foundry Trade Journal.

Sir,—In your issue of January 31, 1935, Vol. 52, No. 963, page 88, there is printed a letter signed V. Delport, entitled "The Oldest Grey-Iron Casting."

I am enclosing a book which I wrote in 1933, in which you will find on page 9 of the Historical Section, a reference to "the Earliest Known Piece of Iron Casting"—being a tombstone in Burwash Church, Sussex, which dates from the 14th century.

In checking my source for this statement, which is page 3 of Dr. Moldenke's book, "The Principles of Iron Founding," I find that I was in error, because this casting is dated 1450, which makes it the 15th century. I do not know whether your correspondent differentiates between grey-iron casting and cast iron, but if he does I think that the Nambu kettles, to which I have referred on page 10 of my historical sketch in "Elementary Foundry Practice," deserve a place in history as early examples of grey-iron castings.

Incidentally I find on page 3, of Moldenke, "Principles of Iron Founding," a reference to having "record of a bridge with cast-iron chains being built in Japan in the year A.D. 70."

I can find no authority for such statement. In fact, there is no historical document in Japan which dates beyond the 6th century.

References are made in Chinese and Korean history to Japan, but I think that perhaps Dr. Moldenke has been misled by a reference to iron casting in Japan during the Kamakura period A.D. 1270—perhaps someone will give us the source of the late Dr. Moldenke's Japanese reference?

Yours, etc.,
James A. Rabbitt.

Japan Nickel Information Bureau,
Municipal Research Building, Hibiya Park, Tokyo, Japan.
March 8, 1935.

Mr. Rabbitt's reference to Nambu kettles is contained in the following statement:—"A unique local development of the cast-iron industry is that of the Kawaguchi district, near Tokyo, in which the entire population of the village has been engaged in iron casting since the Kamakura period (A.D. 1270). There is a clear record that since the reign of Toyotomi (A.D. 1583) the people of this district have enjoyed considerable fame for their skill in the art of casting iron."

Spectrographic Analysis of Aluminium

At the annual general meeting of the Institute of Metals, held in London recently, Mr. D. M. Smith read a Paper on "The Spectrographic Analysis of Aluminium." In the research described, ordinary photographic records of arc and spark spectra of graded series of standard alloys of aluminium with copper, iron, manganese, silicon and titanium were investigated from the point of view of the establishment of a satisfactory routine method of analysis. The spark was found to give a steadier and more reproducible source of light and, since adequate sensitivity of detection of the impurities usually occurring in aluminium was obtained, analytical tables were compiled for use with the spark method. For routine testing of samples an auxiliary alloy of aluminium with 1 per cent. nickel was used for the auxiliary spectrum method, but further accuracy of determination would be obtained by direct comparison with suitably-selected standard samples. The arc method was more sensitive for the detection of traces of such impurities as lead and gallium.

Large Marine Turbine Gear Wheel

The accompanying illustration shows a large marine turbine gear wheel leaving the works of The Power Plant Company, Limited, West Drayton, Middlesex, on a G.W.R. "Crocodile" on its short journey to Brentford Dock for shipment to Mobile, Alabama, U.S.A., for the 22,000-ton Eagle Oil Company's oil-tanker s.s. "San Fernando," which stripped her gears during a hurricane in the Gulf of Mexico. The gears, which were not originally supplied by The

Power Plant Company, Limited, were shipped from Mobile to West Drayton for them to replace.

To give an idea of the size of the gear wheel, no traffic could pass it on its short 40-min. journey from the works to Brentford, in consequence of which the journey could only be made early on a Sunday morning.

Catalogue Received

Alloy Steels. A new note has been struck in the brochure, "Some Notes on Alloys Steels," by Samuel Fox & Company, Limited, Stocksbridge Works, near Sheffield. Usually such catalogues contain long lists of steels, together with the heat-treatments and ultimate use. In this case, one is led systematically through the last three decades, and line drawings are given of the various types of furnaces used in steel metallurgy. Then some elementary notions of heat-treatment are given, followed by a study of the effect of various elements in mechanical properties. The last section is devoted to the application of these special steels. We imagine that this brochure has been produced a little too quickly, as there are several typographical errors. We appreciate the elimination of the numerous trade marks which used to be so characteristic of the Sheffield trade. The unification of all brands under the name "Fox" is commendable. This brochure should be obtained by all our readers on the foundry side, as they will acquire very quickly a sound knowledge of what the special steel business really stands for, and how it can help them in their own problems.

Canadian Metallurgical Improvement Continues

Following substantial increases in the output of iron and steel in Canada last year, a further improvement was registered in January. Production of pig-iron at 44,416 tons was 5 per cent. over the 42,364 tons of December and 45 per cent. over the 30,677 tons made in January, 1934. Production of steel ingots and direct steel castings was 59,526 tons in January, being a slight improvement over the 58,732 tons of December and comparing with 60,787 tons in January, 1934.

Random Shots

Mr. Copehendrag on the Dance.

When Mr. Copehendrag (of Copehendrag's Bijou Jobbing Foundry at Bolton) comes to Town he likes to relax. Life has been a rather strenuous affair for him lately. He has just delivered to one of his clients a cast-iron winding staircase, which had to be cast in one piece according to the customer's instructions. He looked into The Foundry Trade Journal office last Monday to tell the Editor all about it, and there he and "Marksman" happened to meet. The result was that "Marksman" became responsible for Mr. Copehendrag's entertainment that evening, and after racking his brain he decided to take him to the Coliseum, where the vaudeville that was being staged included a production called "The Foundry." This, according to the programme note, was a descriptive ballet, the music being the Finale of Beethoven's "Seventh Symphony." And now let Mr. Copehendrag give his impressions.

* * *

"Ah went wi' that young fellow 'Marksman' t' see dance called 'T' Foundry.' It were reet good fun an' all. Curtain went up and there was th' exact image of the Bottle-by-the-Billboard shop where Ah served my time. 'Twere rather gloomy to look at at first. In one corner was t' furnace. Ah doan't know quite what sort o' furnace 'twere; must have been a pit furnace, Ah reckon. ('But tha should know,' said 'Marksman,' when Ah ask't him in a whisper what *he* thought.) Anyway, it looked as though 'twere reet good and hot. Overhead there was a sort o' crane and a big ladle wi' special tilting gear. Ah wished Ah'd had time t' look properly at that ladle. Reckon Ah might have got an idea for t' Bijou an' all. There were half-a-dozen chaps who were melters, Ah fancy. They were dressed up in black tights and little round black hats. An' t' foreman, who ought t' have known better, was dressed just t' same, but in green. He started to get moithered, jumpin' up and down, and runnin' here and there. Ah was that nervous he'd start usin' language, for Ah knew he'd make it hot for some o' them.

* * *

"Just when Ah thought he were goin' to fire 'em all, out t' furnace popped young lass, dressed in a bit of flame-coloured stuff. The furnace looked that fiery Ah wonder she didn't jump higher than she did. She whirled about all over t' place, standin' on her toes and causin' a rare to-do among the melters. Then foreman began to look mad again and back she popped into furnace again. Then the melters, they too had a go at jumpin' about, gettin' floor ready Ah reckon, for when they'd done there came a sort of whir and the ladle tilted and out shot a stream of good hot metal—or what looked like metal. And then on to the stage from just under the ladle came a lot of bonny looking lasses who were supposed to represent sparks. The melters, they got busy tryin' to stop 'em spreading about t' shop, but for a time 'twere a 'eart-breaking job and one poor fellow slipped up like and were completely covered with sparks and so burnt that his mates had to pick him up and carry him off.

* * *

"All this fuss about sparks annoyed t' foreman fellow who got real mad again, and before you could say 'Jack Robinson' the melters had t' sparks under control and were once more in charge. They were that pleased that they started jiggin' about in triumph on stagin' round furnace and when the curtain came down they were just about ready for tapping out."

Marksman.

Modern Marine Propellers*

A REVIEW OF MANUFACTURING METHODS

By J. E. NEWSON

From time to time the imagination of the public is stirred by the news and pictures in the Press of some outstanding achievement in industry, which, by virtue of either its size or complexity, has presented unusual problems to the manufacturer. To the ordinary reader the interest is generally fleeting, and its appeal lies most probably in the success attained by his fellow-countrymen in completing a difficult job, and he feels entitled to a small share of the reflected glory. But to those in the particular trade or allied trades, the interest is more deep rooted, and whilst they may not regard the accomplishment as a modern marvel, they do appreciate the significance of the steady progress which is being made.

The launch of the giant Cunard-White Star liner by H.M. the Queen served to focus the interest of the whole nation on the details of construction of this, the world's largest, passenger vessel. The "Queen Mary" is unique in many ways, and not the least of these is that she is fitted with four propellers which are the largest individual castings in manganese-bronze ever produced.

On account of their size, they presented many special problems, but there was no marked deviation from normal practice in the preparation of the moulds, and it is proposed, therefore, to give an account of the general routine methods of manufacture, with special reference to the "Queen Mary," "Normandie" and "Empress of Britain," etc., at a later stage.

The history of the development, alone, of the screw propeller provides enough material for a lengthy Paper, but it may be of interest in passing to mention that previous to 1879 all propellers were made of cast iron, cast steel, or gunmetal. All these materials had relatively low mechanical properties and the ferrous alloys were subject to severe corrosion in sea water.

In 1876 Mr. P. M. Parsons evolved a new alloy known as manganese-bronze, which was the original of the many complex special bronzes and brasses which are in use throughout the world to-day. The first alloy was a true bronze, *i.e.*, a copper-tin alloy, strengthened by the addition of iron and manganese. The manganese brasses, complex variations of the copper-zinc alloys, were also developed by him.

The strength and ductility of the new alloy, coupled with a marked immunity from attack by sea water, prompted him to make one of its first applications the manufacture of marine propellers. So far as can be ascertained, the first vessel equipped was H.M.S. "Colossus" in 1879, and the improvements obtained were so remarkable that its general adoption followed, and during the last 56 years manganese brass has been used for the propellers of the world's navies, the greater part of the mercantile marine, and every passenger liner of importance. Research work is still in progress to obtain even higher mechanical properties and improved durability.

Perhaps the most interesting way to review the founding of a propeller is to follow the sequence of operations from the design office through the various shops to the final balancing, referring briefly to all, but devoting more detailed consideration to the foundry aspect.

Design

Each individual propeller is designed to suit the particular vessel for which it is intended. Certain essential data are necessary to the designer. These relate to the size and form of the vessel, the revolutions and power of the engines, the required performance, size of shaft, etc., and from these he decides on the main characteristics of the propeller, which are the diameter, the pitch, the area of the blades, the shape of the section, the thickness of the sections at fixed datum points, and the inside and outside diameters and length of the boss. During the last few years propeller design has advanced considerably, striking improvements in efficiency having been obtained with a notable decrease in erosion and cavitation wastage.

Drawing Office.—The design is handed to the drawing office, who prepare the working drawings to scale for use in the shops, indicating all the necessary details. The works drawing-office staff is responsible for pitching, thicknesses, and adherence to drawing.

Patternshop.—The drawings sent to the patternshop enable them to prepare the necessary pitch rail and striking boards for the blades, the boss of the propeller and the core, as well as the section pieces and tip pieces.

Foundry

Depending upon the size of the job, the mould is built up on either a permanent plate in a pit, or a movable plate on the foundry floor. In the case of the large moulds, it may be necessary to dry them in position in the pit, but lighter work can be transported bodily to the stoves for drying. In each instance the base of the mould is a circular cast-iron plate of suitable diameter, and this is set perfectly horizontal. Through a hole in the centre is mounted a stout vertical steel spindle fitted at the top with suitable pulleys, and on this spindle are mounted the sleeves which carry the striking boards. The baseplate is marked out with 120- and 90-deg. angular spacings to suit three- or four-bladed propellers respectively. The pitch rail or pitch piece, prepared by the patternmaker is to guide the striking board over the correct helical plane. It is a curved inclined rail rigidly mounted, the angle of inclination coinciding with the required pitch. Some propellers are "true pitch," in which case the pitch is constant, both along and across the blade, and does not depart from the struck-up pitch. Variations in pitch are a feature of some modern designs, and the modifications are introduced by rubbing down and building up to templates on the beds, after the true pitch has been struck. The striking board has small grooves cut in the edge at predetermined radii. On the baseplate the foundations of the bed for each blade are marked out, and building up with brick and loam is commenced on the first blade. The brickwork is built chequer-wise for drying and venting, old loam is used for the backing, and a large percentage of new loam with cow hair is used in the facing. The surface is struck up by the board, mounted on the sleeve, to which a rope is attached. The rope passes over the pulley to a balance weight. On the outer end of the board a small roller is fixed. This roller bears on the pitch rail, and when the balanced sweep board is used for striking up the mould, it thus reproduces the intended helical face of the required pitch. The surface as prepared will be the face of the blade of the finished propeller. The blade striking board is removed and replaced by the boss board, and the boss and core prints are similarly swept up. When all the bottom halves are struck up, they are dried off, either in the pit or in stoves. The dried faces are then swept again with the striking board, to which a steel edge has been fitted. The ridges at the various radii produced by the grooves serve to locate the section pieces. These are thin strips of pliable wood, corresponding to the drawing section of the blade at that radius, plus contraction and machining allowances. They are anchored in position with sprigs, the tip pieces and edge strips are placed, the intervening spaces filled with bricks and sand, and the upper surface sleeked off, thus producing a complete sand pattern of the blades.

This is then dusted over with parting sand. Edge plates for the joints are set, and a strong framing of mild-steel strip and rod is built over the sand pattern, to which the hangers are later attached. The face of the top half is then made up in soft loam, followed by the backing of loam and brick in the reverse order to the bottom, finishing with separate cast-iron plates for each blade part. The boss is again struck up, so that the upper halves of the mould now complete the circular form. After drying, the tops are parted (being marked up for matching in replacement) and are transferred to the drying stoves to complete the removal of moisture. The sand pattern is removed together with the section pieces, tips and sprigs, and the mould face touched up where necessary. The core is struck up in the usual way of straw rope (on a metal barrel) and faced with loam on a horizontal machine. The riser head is struck up on a plate with vertical spindle. The downgates and ingates are made of loam in cast-iron boxes, and the ingates are built into the brickwork of the beds. For castings weighing less than 12 tons, one runner, and for 12 tons and upwards two runners are used. At the foot of the downgate is a heel and a short blind end, below and parallel to the ingate, to take the first rush of metal and to trap the dross formed by the drop of the initial entry. The size of the gates varies naturally with the size of the job, and is usually about 2- to 3-in. dia. The ingates have a very slight upward slope to bottom edge of the boss.

Mould Drying

It is essential that, before casting, the mould shall be perfectly dried. The stoves for this purpose are of the latest design, and are of large capacity. Large volumes of hot air must circulate through the stove, and it has been found that, with the "Herrmann" principle of heat-storage accumulators, satisfactory results are obtained.

The temperature of the stove reaches a maximum of about 350 deg. C. during the firing period, and during the hot-air circulation drying period falls steadily to about 200 deg. C. after 12 hrs. For a large mould, such as the "Normandie," about 100 hours' drying were necessary.

The dryness of the mould can be tested by holding cold iron rods in apertures running through the brickwork, when there should be no signs of "sweating" or condensed moisture after remaining there for about a minute. After drying the mould shrinks a little, and the surface cracks are opened out and carefully filled, and the whole blacked over with a wash made up of plumbago and china clay.

After blacking-off comes the final drying and assembling, and making up of joints. The tops and bottoms are bolted together, a large binding ring secures the whole as one unit, and a sand bed is rammed round the complete mould. If not in a pit, the sand bed is contained in curved steel plates. The core is placed in position in its print, gauged for concentricity with the boss and secured. A large pouring box is mounted over the downgate. These boxes vary in size, holding 1 to 4 tons of metal, and can be closed by a plug. The mould is now ready to receive the metal.

Furnaces

New metal is made up in crucible tilting furnaces of 6 cwts. capacity, and then cast into ingot moulds. For castings over 2 tons, coal-fired reverberatory furnaces, ranging from 4 to 12 tons capacity, are used. These operate on

* A Paper read before the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, Mr. G. T. Lunt presiding.

low-pressure forced draft. The day previous to casting, the furnaces are charged with ingots, risers and runners from previous casts, and on the day of casting they are lit up so that the charge will be ready shortly after the mould is ready, to avoid any stewing of metal. Thermo-electric pyrometers are built into the furnaces, so that the temperature of the bath is under continual observation and control by draft regulation. Charcoal and salt provide the cover for the molten bath. Since the composition of the alloy is calculated exactly in making up the charge, it only remains to control the zinc content. A small finger test is poured into a chill mould and allowed to cool. It is broken when cold and the appearance of this fracture to the eye of an experienced observer gives an accurate indication of the spelter correction which is necessary. Additions of preheated spelter are made as required, and, if necessary, further tests are made until the adjustment is correct and the due allowance made for loss of spelter during tapping. The corrections necessary rarely exceed 0.5 per cent. of the weight of the bath.

Casting

When the mould is ready, the furnace or furnaces are tapped, the metal then being at about 960 to 970 deg. C. The dross is skimmed off, care being taken to obtain as clean a surface as possible. The plug is set in the pouring box and the metal poured in. When the box is nearly full, the plug is lifted, and the metal passes from the down runner, through the cleaner gate to the ingate and enters the mould at the bottom of the boss, whence it flows out into the blades. A head of metal is maintained in the pouring box and any dross formed floats on the surface. Skimmers are used to hold back any dross formed by the metal and to prevent any entering the blades or lodging against the core. The ideal aimed at is to reduce turbulence to the minimum. Pouring is continued until the metal has filled the mould completely and risen into the riser head to a predetermined height, and the dross collected in the head is removed with perforated hand-ladles.

When manganese-bronze solidifies, it undergoes considerable contraction, and it is necessary to provide for this to ensure sound castings free from draws and contraction cavities. This is met by following up with relays of hot metal, melted in conveniently-placed crucible tilting furnaces. As a protection against oxidation and cooling of upper metal in the head, a covering of powdered charcoal is put on, and by the use of feeding rods the metal is kept from bridging. In this way the freezing of the casting takes place from the bottom upwards, and the supply of molten metal in the head is allowed to exert a full hydrostatic pressure on the metal beneath, so feeding down and making up for the contraction. The feeding may continue in the case of a large casting for several hours.

Finishing

After an appropriate time has elapsed, depending upon the size of the casting, the bolts are eased, the sand backing in the pit is dug out, and the tops lifted. When the casting is practically at shop temperature, it is stripped from the mould. The runners are cut off and the core removed, and in the machine shop the head is parted off and the fore end of the boss faced up. On removal from the machine, the casting is set face up on jacks and accurately levelled, and the first pitching done. The test-pieces are stamped by the inspector and cut off.

After boring, the keyway is cut and a perfect fit to the cone gauge or template is obtained. The blades and boss are finished to drawing sizes by pneumatic chisels and electric grinders, and the final pitch is checked and proved. The pitch accuracy called for on the highest class of propellers is of the order of 1/10th of 1 per cent.

If the propeller be required to be balanced, it is given a preliminary trial before the final grinding. A mandrel is fitted through the bore and projects, and is allowed to rest on two hardened-steel rails horizontally mounted over a pit. The inaccuracy of the balance is determined by allowing the propeller on its mandrel to roll on the rails (when the heaviest blade will come to rest at the lowest position) and noting the counterpoise weights required to be added to the other blades to attain an even balance. Each blade is checked in turn against the others, and the necessary amount of metal—usually only a few pounds—is removed from the appropriate area on the back, the relative position affecting the turning moment.

When the balance is obtained, the final polishing of blades and boss is completed. In the meantime the test-pieces have been prepared and inspectors representing the owners and/or the usual classification societies visit the works to witness the tests and balance, gauging and pitching and for final approval and acceptance.

The manufacture of loose blades follows almost exactly the same procedure. The blade is struck up on a plate with pitch rail, sand pattern built up to section pieces, and the top half is made up. No boss core is required, but the recesses for the holding-down bolts are formed by a loam core from a corebox and a pattern used for the flange. The riser head is struck up, the two halves of the mould are bolted together, transferred to a pit and cast. The pitching and finishing are similar to the treatment of solid screws.

Alloys

The alloys used are manganese brasses having a range of composition and mechanical properties to suit the specifications of the British and other naval authorities, and the principal shipping lines. The principal alloys are:—

	Proof stress.	Ultimate.	Elongation, per cent.
Parsons M.B. Admiralty	16 tons	33	15
,, M.B. ..	16-17 tons	30–34	20–25
Turbadium ..	18-20 tons	38–40	15–20

The first two are alpha-beta alloys whilst Turbadium is a nickel-bearing beta alloy possessing remarkable resistance to erosion. Special attention must be paid to the control of the composition, melting and pouring temperature to secure the best mechanical properties of the propellers, as the best metal can be damaged by wrong conditions of melting. Some forethought must be given also to the weight of metal required for the casting itself and the feeding metal. The weight of the finished propeller plus machining and trimming allowance is calculated from the drawing. To this is added the weight of the runner, the weight of the cast riser, the spelter for melting loss and the feeding metal. As an example 16 tons total was required to cast a propeller weighing 12 tons in the finished state.

The proportions vary somewhat with the size and design of the job.

Name of vessel.	Nationality.	Cast weight, in tons.	Finished weight, in tons.	Ratio finished weight cast weight.
"Queen Mary"	British	55½	35	63 per cent.
"Empress of Britain"	British	35½	25	70 ,,
"Normandie"	French ..	32	22½	70 ,,
"Bremen"	German ..	30½	20½	67 ,,
H.M.S. "Hood"	British	33¼	20	60 ,,
"Mauretania"	British	30	18½	62 ,,
"Viceroy of India"	British	21	16½	78 ,,
"Conte di Savoia"	Italian ..	25	15¼	61 ,,
"Europa"	German ..	22½	14	62 ,,

Casting

Particulars of some of the large propellers manufactured by The Manganese Bronze & Brass Company in recent years may be of interest.

It will be seen that the ratio of cast to finished weight fluctuates, and this is influenced by the number of blades, the shape of the blades, and particularly by the diameter of the boss.

"Queen Mary" Propellers

For the casting of the "Queen Mary" practically the whole of the furnace capacity was required to secure the main pour of 48 tons. All furnaces were to be ready to cast exactly at predetermined times and intervals, to use the crane capacity to the best advantage, and to get all the molten metal into the two casting ladles and alongside the mould, skimmed and ready for pouring without delay. This weight of 48 tons was required to fill the mould completely and the riser over the boss to a height of 16 in. The average time for the four individual casts was 9 min. The feeding metal amounted to a further 7½ tons and was added in relays over a period of 4 hrs. When solid the height of the head was 30 in.

By a simple calculation based on the diameter of the head and core, it is found that, had there been no contraction, the feeding metal would have raised the level in the head to 41 in. The difference on levels 41 in. and 30 in., *i.e.*, 11 in., represents the sinking due to contraction, and represents a volume of 24,680 cub. in., or 14.34 cub. ft. The castings took 14 days to cool down before they were stripped. The time required for the preparation of the mould and core, and assembly, amounted to about seven weeks, and it is estimated that the dried mould, before casting, weighed approximately 85 tons.

The propellers for the "Normandie" are of a different shape, the blades being short and wide and relatively thin with a long boss. These characteristics have given a lighter weight of propeller, but owing to special features of the blades the moulding time was about the same as for the "Queen Mary."

A finished propeller is a casting of which any firm might reasonably be proud, since it is of mathematical exactitude, of remarkable strength and pleasing appearance, and capable of resisting the corrosive attack of all sea waters of the globe.

As an illustration of the severity of the service which has to be rendered by such propellers, it is of interest to mention that the tips of one of the propellers made by The Manganese Bronze & Brass Company, which was in continuous service on the famous "Mauretania" for 15 years, is estimated to have travelled a distance equal to five journeys to the moon and back, and then was only removed on account of accidental damage.

In conclusion, the author would like to express his thanks to his directors for permission to publish this Paper.

DISCUSSION

Opening the discussion, Mr. G. W. Brown recalled that many years ago he was connected with a firm which did a great deal of shipbuilding work. One day a ship was docked that had two of the four blades of her propeller missing. A propeller to replace the damaged one was required in a certain number of tides. The men made such a good job of it, and got it through so quickly that, to encourage their enthusiasm, he allowed the propeller to be set up and photographed. The metal was cast iron. (Several slides showing the propeller referred to were

(*Concluded on page* 238)

The Use of Sodium Carbonate in Iron and Steel Works*

By N. L. EVANS, B.Sc., A.I.E.

This Paper, which was published in our issue of April 5, 1934, was brought up to date by references to some of the most recent results obtained with the sodium-carbonate process for the treatment of cast iron, and the design of plant specially adapted for carrying it out. The following is a summary of the points mentioned which were not included in the original Paper read at Sheffield last year.

A drawing was shown of a cupola and open-topped receiver, with an effective form of slag trap in the connecting lander between them (Fig. 1). Provision is made for running off any slag which accumulates on the cupola side of the trap. Some such device as this is desirable, as it prevents a reversal of the desulphurising action of soda slag in the receiver. In the presence of cupola slag, such a reversal is liable to occur in accordance with the equation:

$$Na_2S + SiO_2 + \frac{MnO}{FeO} = Na_2O.SiO_2 + \frac{MnS}{FeS}$$

A method of using a teapot ladle as a receiver was also illustrated (Fig. 2). This lay-out is designed for use in light-castings foundries, where it is common practice to use bogie ladles of 7 to 10 cwts. capacity. Delay is sometimes caused if sodium-carbonate treatment is carried out in such small ladles, one of which has to be filled every two or three minutes. But by interposing a teapot ladle of suitable capacity, in which the sodium-carbonate treatment can be most effectively carried out (as there is no need to use ground limestone to thicken the slag), a constant supply of treated and deslagged metal is available for filling the bogie ladles.

Desulphurisation is generally regarded as secondary to some of the other effects of the sodium-carbonate process, such as degasification, refining of graphite and improvement in machinability. In fact, there are still numbers of foundrymen who favour a moderately-high sulphur content for improving the wear resistance of castings. While the lecturer did not agree entirely with their point of view, it was possible to give a measure of control over the removal of sulphur, by varying the percentage of ground limestone mixed with the sodium carbonate. The figures given below illustrate this:

Control of Sulphur Reduction.

Untreated metal	Sulphur 0.100 per cent.
Treated with a mixture of 1 lb. sodium carbonate and ¾ lb. ground limestone per 1 cwt. of metal	Sulphur 0.079 per cent., *i.e.*, 21 per cent. removed.
Treated with 1 lb. of sodium carbonate per 1 cwt. of metal. Limestone added afterwards to thicken the slag ...	Sulphur 0.046 per cent., *i.e.*, 54 per cent. removed.

Reference was made to the increasing popularity of fused sodium-carbonate blocks for keeping the inside of the cupola clean. This results in a considerable saving in ganister and in the time required for patching.

As an illustration of the value of the sodium-carbonate process in improving the structure of cast iron, a recent very startling improvement in the life of ingot moulds was quoted. The average life had been increased by 40 per cent., from 55 heats to 77 heats.

In dealing with the treatment of chilled rolls, the lecturer made the suggestion that "spread mottle"—to which so many roll makers object, should be much more resistant to the effects of sudden local changes in temperature than metal with a sharp line of demarcation between the outside chill and the grey iron of the core. The slight extension of this mottle towards the core, which sometimes occurs in rolls treated with sodium carbonate, should be an advantage, in view of the much tougher grey-iron core which the process produced.

In conclusion, a series of slides was shown, illustrating the making of an important casting,

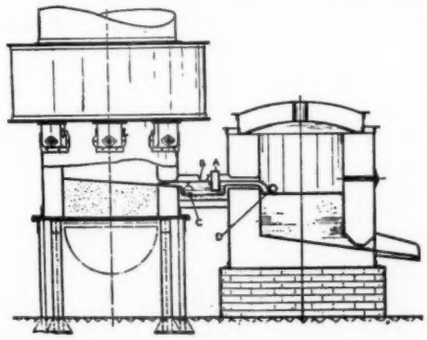


Fig. 1.—Receiver Adapted for Use with Sodium Carbonate, showing Method of Connection with Cupola.

weighing some 20 tons. The addition of sodium carbonate, and the removal of slag from the ladle were both shown.

DISCUSSION

Mr. J. L. Smithson referred to the fact that the sodium-carbonate process was not new, reference being made to it in the literature as far back as about 1860. He suggested that the removal of silicon from the metal by sodium carbonate was largely responsible for the sulphur reduction. Silicon removed oxides, and the efficiency of desulphurisation depended on the reducing or oxidising conditions, desulphurisation in the electric furnace being instanced as a parallel case.

Regarding the quantity of sodium carbonate to use, and the influence of the time factor, his

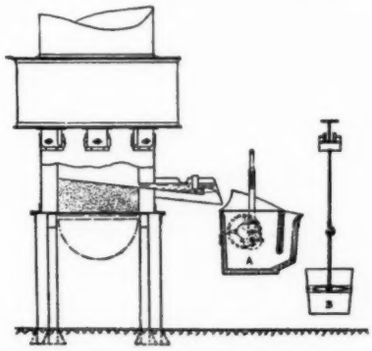


Fig. 2.—Teapot Ladle (A) Used as a Receiver.

own experience was that, using ½ per cent. of sodium carbonate, satisfactory desulphurisation took place rapidly, and the metal could be tapped without a long waiting period. He was referring to bottom tapping from a receiver. With 1 per cent. of sodium carbonate, the time factor was more important; and if the slag was allowed to cool on the metal to any great extent, the reaction was reversed.

Mr. Smithson confirmed the lecturer's remarks regarding the innocuous effect of sodium carbonate on refractories, and quoted his own experience of a ladle lining made of old firebricks, properly jointed, which lasted for some 600 heats.

Mr. J. E. Mercer asked what percentage of sulphur could be removed from cast iron by the use of fused sodium-carbonate blocks in the cupola. Also, when using the ladle method of treatment, did the process result in slag inclusions in the castings? He had had to keep metal in the ladle for as long as 20 min., owing to the apparently continuous separation of slag which was taking place. Would this be likely to result in an appreciable loss of temperature?

Mr. D. Guthrie asked why there could be any desulphurising action by the use of sodium carbonate in the cupola, in view of the lecturer's statement that cupola slag inhibited desulphurisation. Did the process have any effect on the phosphorus in cast iron?

Mr. J. G. Gould, referring to one of the slides illustrating a contraction cavity in a pipe casting, said that, in his experience, such defects were often the result of using too much scrap in the cupola. He asked whether sodium carbonate had any effect on contraction.

Mr. J. C. Charlton referred to the question of deslagging, and said that slag still appeared to be present after continuous raking. He asked whether it is necessary to rake off the slag more than once.

The President (Mr. J. Hackwood) said he, too, had thought it necessary to keep skimming a ladle several times, and asked whether this was necessary.

Author's Reply

Mr. N. L. Evans, replying to the discussion, agreed that the sodium-carbonate process had been known for a long period. The earliest reference he had been able to trace was to its use by Horsley, of Derby, in 1867.

With regard to the removal of silicon being partly responsible for desulphurisation, and the suggestion that the reducing or oxidising conditions present, governed the efficiency of the process, he considered that basicity was a much more important factor. One could not be dogmatic about some of the chemical reactions taking place at elevated temperatures, but he thought the equations he gave represented the most probable reactions. In the case of the electric furnace cited by Mr. Smithson, desulphurisation could only occur with a basic lining, and the carbide slag was normally present.

Very careful research had been carried out regarding the most suitable amount of sodium carbonate to use when treating cast iron. The recommended proportion of 1 per cent. gave much better results than ½ per cent., and if the amount was increased to 1½ or 2 per cent., desulphurisation was not increased to the same degree. But in cases where the metal was in contact with the soda slag for a comparatively long period, as is often the case in a receiver, the time factor becomes important, and rather less than 1 per cent. may be quite effective. No reversal of the process would be expected, except in the presence of acid slag or sand.

Mr. Smithson's remarks regarding refractories were most interesting, and confirmed the lecturer's own experience.

In answer to Mr. Mercer's first query, the amount of sulphur removed by the action of fused sodium carbonate in the cupola varied from nothing at all to over 60 per cent., dependent on the basicity of the cupola slag. In some foundries the amount of limestone used as a cupola flux was very small indeed, and while sodium carbonate under such conditions might prevent sulphur pick-up from the coke, no desulphurisation of the metal could be expected. With an average cupola slag, the removal of

(*Concluded on page* 239)

* A Paper read before the Middlesbrough Branch of the Institute of British Foundrymen. Mr. J. Hackwood presiding.

Nickel Demand Continues

By "Onlooker."

The present negotiations for the institution of an agreement to effect world curtailment of copper have inevitably led to consideration of the situation in nickel which is produced mainly in Canada in conjunction with copper. It is true that a certain amount is found in New Caledonia and there is also some production from Norway, but for all practical purposes Canada is the home of nickel, and the world looks to the Dominion for its supplies. From the very beginning of the copper-curtailment talks it has been apparent that the chances of Canada reducing her actual output of copper were remote, and suggestions have, therefore, been put forward that a portion of the copper produced should be looked after in a pool. That is, however, a matter for the copper people themselves to decide, but the main thing from the point of view of those interested in nickel is that the output of this all-important metal will be maintained.

Last year's output of nickel showed a big increase, something like 50 per cent. as a matter of fact, for from about 41,500 tons it jumped up to 65,000 tons in 1934, this comparing with some 16,000 tons in 1932. A production in excess of 5,000 tons per month is fairly high and, unlike other metals, none of this was put into stock, for as a matter of fact the nickel people had quite a task last year to keep pace with the demand, which increased very rapidly. To their credit let it be said that the call was met, and neither in this country nor abroad did anyone go short of an essential raw material, although some of them may have been a little worried from time to time when it looked as if the prompt delivery they asked for would hardly be forthcoming. They got what they wanted, however, and one must hope that the excellent staff work by the nickel producers will be remembered by the consumers, who were certainly well up against it last year. In justice to users, let it be said that although nickel certainly stands very high in price compared with most of the other non-ferrous metals, there are no murmurs of dissatisfaction to-day, and one imagines that with the tin debacle fresh in their minds manufacturers are glad enough to see the price of their raw material held at such a steady level.

All the figures for 1934 are not yet available, but it is of interest to know that Germany imported about 5,000 tons of nickel last year, while Japan was probably not very far behind, her 1933 tonnage being 3,000 tons odd, while Russia was slightly ahead of this. America is, of course, the big buyer of nickel, and she takes a very large tonnage every year, which is employed in a variety of manufactures, alloy steel for automobiles and other purposes being one of the most important outlets. Other important directions of use are nickel silver and, of course, electro-plating, while there is a considerable demand for rolled and drawn articles in nickel without alloying. Mention must also be made of Monel metal, a copper-nickel alloy which is made direct from special ore, and is used widely for manufacture into tubes, rods, etc. Nickel was very much in demand during the war in connection with armour plating and other armaments, and it must be presumed that at the present time a very fair quantity is being taken up in the manufacture of articles other than those of a purely domestic nature, for, as far as munitions are concerned, nickel is of the greatest possible importance.

Quite apart from the armament industry, however, the use of nickel is always being extended for the progressive policy of the producers, as evidenced in the work carried on by the Bureau of Information on Nickel, is constantly being reflected in the discovery of new alloys which bring fresh possibilities into the engineering field. The outlook for the nickel industry is certainly a bright one, and the successful progress of the controlling company is well deserved.

A.S.T.M. Committee on Properties of Metals at Low Temperatures

A new Committee on Properties of Metals at Low Temperatures has been organised by the American Society for Testing Materials. This is to be a sub-committee of the Joint Committee on Effect of Temperature on the Properties of Metals. For the purpose of its work, the Committee has defined low temperatures as any below room temperature, that is, 70 deg. Fah. This subject is of great interest to many branches of industry, because of the subnormal temperatures at which equipment must work, such as railway equipment in northern climates, airplanes flying at high altitudes, in the liquefaction of gases, dewaxing of oils, etc. The Committee will send out immediately a questionnaire to elicit information on what test and research work has been done, the type and nature of such tests with results, and also what particular phases of the problem are of most immediate interest to industry. A bibliography is to be prepared and a general programme of work will be presented for the consideration of the Joint Committee at its next session during the A.S.T.M. annual meeting in Detroit in June.

I.V.E. Visits Frit Works

About forty members of The Institute of Vitreous Enamellers took advantage of an invitation to inspect the works of Messrs. J. F. Stewart & Company, Limited, of Tooting, last Thursday. The party, headed by its chairman, Mr. W. H. Whittle, was received by Mr. W. Thomason, F.I.C., and Mr. J. T. Gray, managing director of J. Gray & Sons, Limited, of 5, Victoria Street, London, S.W.1, who handle the disposal of the output.

The works is pleasantly situated amidst tennis courts, and a well-laid-out garden surrounds the offices and borders the works roads.

The raw materials are weighed out and mixed, using long-handled shovels, after sieving, in specially-designed batch-mixing chambers. The design is such that all riddling and mixing is effected in chambers provided with such efficient dust-extracting that the operatives are free from contamination.

The frit kiln, which has a capacity of about a ton, is oil-fired and charged from overhead, and the waste gases, before entering the stack, pass along flues carrying trays for drying the frit. The molten enamel is tapped direct into a tank of water, and at the time of the visit black enamel was being produced. The material adhering to the spout, and which may later when solid drop into the tank, is exceedingly tough and refuses to be ground. This contamination is later removed by hand-picking. Moreover, the dust is also eliminated by sieving. This, then, after bagging, is the material sent to the works of the vitreous enamellers.

In conformity with the notion of taking their own medicine, a complete vitreous-enamelling works has been established. Here their own frits are ground by either the wet or dry process and both the spraying and dusting processes are used. Thus first-hand information is obtained as to the behaviour of their enamels under practical conditions.

The whole process is under dual control. There is a well-furnished laboratory for testing the raw materials and finished frit, and also an experimental shop for the physical testing of each new batch.

At the conclusion of the visit refreshments were served, and as there was a meeting of the Institute held later in the day, it was reserved until that time to express the thanks of the Institute to the firm and to Mr. Gray, who had sponsored the arrangements.

Visit of The Institute of Vitreous Enamellers to the Works of Messrs. J. F. Stewart & Company, Limited.

The British Cast Iron Research Association

MEMBERSHIP EXTENSION

Since 1924 the British Cast Iron Research Association has nearly trebled its subscription income from the industry, mainly, of course, by extension of membership. During its early years Government grant was received at the rate of £1 for £1 on subscription income, reaching a maximum figure of nearly £5,000 in 1931. During the following three years the grant was reduced to £3,000, and by 1934 the resulting drop in income had been made good from industrial sources, the total income for that year being the highest yet received.

New Government Offer

For the current financial year, H.M. Government, through the Department of Scientific and Industrial Research, has made a generous offer to increase the grant by £2,000, bringing it to the former figure of £5,000, provided that additional subscription income to the extent of £1,000 is forthcoming from the industry. In order to benefit fully from this generous proposal, the Council of the Association seeks the co-operation and support of all foundries eligible for membership.

The chart illustrates (Fig. 1) the increase in industrial income, and total income since the establishment of the Association in 1921 and the amount of grant in any one year is given by the difference between the industrial income and total income. The dotted lines subsequent to 1934 indicate the possibilities of the development arising from the new Government offer, and show that by 1939 the Association may attain a total income of £20,000 per annum. This figure is regarded as the minimum amount required to maintain the Association on the fullest possible scale of usefulness. These possibilities are open because the Government has not only offered an increased grant for the current year of £2,000 provided that an additional £1,000 can be obtained in subscriptions from the industry, but has further offered to provide grant at the rate of £1 for £1 on all subscriptions received over and above the £1,000 up to a limit of £3,500. If the Association, therefore, raises £1,000 extra this year, and a sum of about £750 for each of the four subsequent years, the fullest possible advantage will be taken of the Government offer within a period of five years. It may be noted that when the fall in grant took place, it was reduced from £1 for £1 to something like 10s. per £1 of industrial income. If the new Government offer is properly utilised, a grant of £8,500 will be received on a subscription income of £10,500, a proportion of about 16s. in the £1. As income from miscellaneous non-grant earning sources is of the order of £1,000 to £1,500, the total income can thus be made to reach £20,000 in 1939.

Membership

We recapitulate here some of the points with regard to the Association's constitution and work. The Association is an entirely self-governing body of national status. The Council is elected by members at the annual meeting, and operates principally through three main committees, the Research, Publications and Education Committees. There are no less than eight research sub-committees and over two hundred representatives of members serve on these bodies, and something like fifty meetings are held in the course of a year. The Association is well represented on national bodies, and has very close relations with various Government departments, scientific and technical institutions, manufacturing associations and universities, both at home and abroad. For the first time the founding industry is provided with a technical research organisation capable of maintaining the status of the industry and looking after the interests of founders as a whole.

Membership is in three grades. By far the largest proportion of industrial income is derived from ordinary members, comprising manufacturing firms operating blast-furnace and refined-iron plants, and foundries for the production of castings in grey iron, white iron, chilled iron and malleable iron and steel. The schedule of subscriptions is as follows:—

	Per annum.
Blast furnaces and refined-iron plants	25 guineas
Foundries (grey iron, white iron, chilled iron, malleable iron or steel):—	
Employing under 50 on the weekly pay roll	15 guineas
Employing over 50 and under 250	25 guineas
Employing over 250 and under 500	50 guineas
Employing over 500 and under 750	75 guineas
Employing over 750	100 guineas

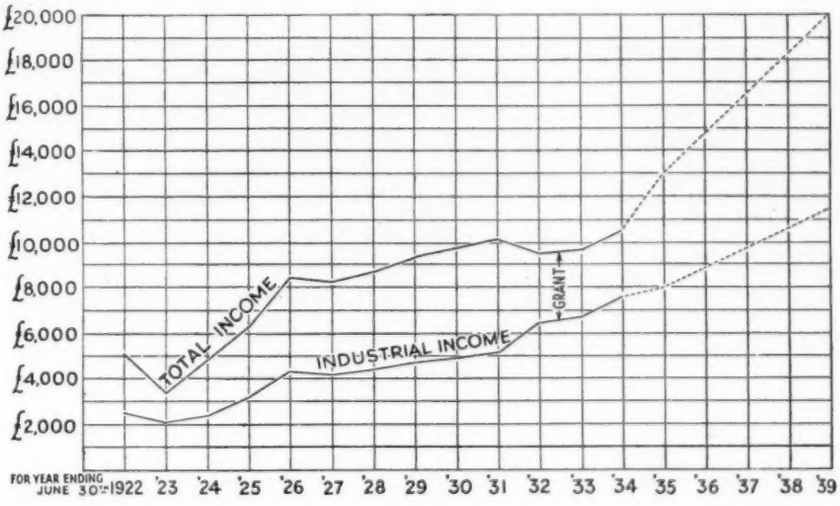


Fig. 1.—The Total and Industrial Income of the British Cast Iron Research Association.

The qualifying employment figure includes all on the foundry weekly pay roll (both skilled and unskilled labour), other than clerks, engineering machinists and patternmakers. These subscriptions are, by arrangement with the Commissioners of Inland Revenue, treated as business expenses for income-tax purposes. With one or two isolated exceptions, the subscription is inclusive, and no charge is made to members for services rendered.

The Council welcomes the co-operation of users of cast iron, that is, of engineering and other firms who purchase castings, and also makers of all forms of equipment and supplies for the foundry industry. For these a special grade of membership is provided with a minimum subscription of five guineas per annum, to which the income-tax rebate also applies. Members in this class do not receive research reports, which are intended for, and are confidential to, manufacturers. Provision is also made for membership of individuals at a subscription of one guinea per annum. Such members receive the quarterly bulletin and the library service. The main object of this grade of membership is to enable persons interested in the industry to keep in touch with the Association until they can arrange for their firms to join as full members, when the individual membership lapses.

Services Rendered

The services rendered to ordinary full members are briefly as follow. The headquarters of the Association, offices and laboratories are in Birmingham. A Scottish laboratory operates at Falkirk for the special interests of Scottish members, particularly those in the Falkirk area. The Association is organised in three main departments, the Research Department, the Development Department and the Information Bureau and Library. These are housed in laboratories in which valuable equipment is being built up, and the assets of the Association are valued at about £10,000. The staff numbers in all about thirty.

The Information Bureau and Library is intended to furnish members with any information they may require on any aspect of the industry. It contains what is probably the most comprehensive collection of information in the world relating to the founding industry. It covers British and foreign text-books, periodicals, scientific publications, patent specifications and commercial literature. It is classified and arranged on a modern system, which co-ordinates and brings together all the material on any one particular subject, and it is in the charge of a properly-trained librarian. Material is loaned to members, and can be borrowed without formality or charge. Additions to the library are notified to members in the quarterly bulletin. This publication, in addition to news of the Association and technical articles, contains abstracts of outstanding or noteworthy developments published in current foundry literature. The abstracting service provides a useful and comprehensive survey of English and foreign practice and periodicals and other publications are received from all parts of the world. The bulletin is now in its fourth volume. Full translations of important foreign Papers are also prepared for the use of members. Non-confidential reports of interest to members are issued as Bureau Reports. The Association does not engage in any form of commercial activity, and has no interest to serve but that of members.

The function of the Development Department is to deal with inquiries from members on any foundry matter in which they are interested. These inquiries are dealt with at the present time at the rate of about four per working day, and cover a very wide field, including raw materials, mixtures, melting practice, sands, refractories, design of castings, after-treatment, defects, etc. All the responsible members of the staff work on

secrecy agreements, and information received from members and reports furnished to them are treated as strictly confidential. The inquiries are not disclosed even to the Council. Tests required in connection with such inquiries in the chemical, miscrescopic and mechanical testing laboratories are carried out without charge. When necessary, members of the staff visit works of members in connection with these inquiries. It is not part of the work of the Association to conduct ordinary routine tests, such as are carried out by many works in their own laboratories, and in many other cases by independent analysts. The work of the Association does not overlap with or duplicate the work either of the works laboratory or of the outside laboratory. The Development Department also assists members in applying to industry in their works discoveries made in the laboratories.

The Research Programme is formulated by the Research Committee, and covers a wide range of problems, including cast iron, moulding sands, refractories, cupola melting, etc. The reports are circulated to members in two forms. Printed reports of general interest are circulated automatically as and when complete, and typescript reports, which are likely to appeal only to a section of the trade, are circulated on request. Over two hundred of these reports have been issued to date.

Other Services

The Association is empowered under its Articles to carry out special investigations for members at cost. Visits from members are welcomed at any time at the laboratories to discuss special problems or work in progress. The Association also receives representatives of members to study for short periods in the laboratories, and in some cases this has been extended to a complete two-year course. The laboratories are devoted to chemical analysis, microscopic examination, mechanical testing, sands and refractories, and research. Periodic meetings of members are held to discuss matters of special interest. These have been held in about ten of the principal cities throughout the country, and this practice of communicating information and promoting discussion culminated at the end of 1933 in a three-day study course, which was attended by a hundred and seventy representatives of members. The success of this was such that the Council proposes to make it a permanent feature of the Association's work.

New Members

There are throughout Great Britain a large number of foundries which have not yet joined the Association, and the Council feels that a wider knowledge of the work of the Association will justify these foundries in the expenditure of the necessary subscription. For the comparatively small sum shown in the foregoing table, they can ensure for themselves the benefits of an income of £10,000 to £12,000 per annum expended in research and development. Many members have found the subscription income returned many times over in the advice and assistance, which have led to economies in production and improvement in quality of the product. It should be added that H.M. Government takes the view that since British industries are now protected by tariffs, it is imperative that they do everything possible to equip themselves technically for meeting the demands of consumers. The Government regards membership of the Research Association as evidence of such a desire on the part of individual manufacturers. Since a large proportion of foundries in the country are outside the scope of the manufacturers' associations in the foundry trade, there is no other way of securing members but by individual approach. Inquiries to the Association at 21, St. Paul's Square, Birmingham 3, will be welcomed, and the director would be glad to visit personally any foundries interested and desirous of considering membership.

The only limitation with respect to membership is that the foundry concerned must be British, that is to say over one-half the capital employed, and/or the directorate, must be British. Foundries excluded by this provision may be elected as full members with the consent of the Board of Trade, and this consent is not unduly withheld provided British labour is employed. British foundries overseas are also eligible for membership, and the Association has members in Australia, New Zealand, India and South Africa. The rapid development of the air mail has overcome the principal handicap to membership of foundries overseas, which is that of the time lag in communication.

The acquisition of fifty members per annum for the next five years will enable the Association to take the fullest advantage of the Government's generous offer, and all non-member foundries are urged to give serious consideration to the question of membership.

In conclusion, it must be stressed that in practice no difficulty whatever has been found in ensuring the co-operation of members on a technical and scientific basis. It should be remembered that for a very long period cast iron was failing to hold its own as a material, and scientific investigation alone has enabled it to strengthen its position by revealing its merits. Not only has its use in the past been threatened by the substitution of other ferrous materials, particularly of wrought materials, but the extended use made to-day of synthetic materials of the bakelite type also requires to be watched. The existence of a strong technical body enables statements by those producing competitive materials to be met and refuted. In many ways which it is undesirable to disclose, the Association is able to promote the interests of founders as a whole.

Modern Marine Propellers

(*Concluded from page* 234)

exhibited.) Continuing, Mr. Brown said he had the greatest admiration for those who designed the propeller described in the Paper. He was astounded to hear of the amount of work and calculation involved. He would like to know if he was right in supposing that modern developments were in a great measure due to advances made in the aeronautical world. He was surprised to learn that the blades of propellers were chipped by hand. Surely some mechanical method was possible, for example, by the use of a profiling machine. It would be of great interest if Mr. Newson could give them some information about propeller failures from causes other than erosion and general wear.

Mr. Newson, in reply, agreed with Mr. Brown that propeller design had developed along aeronautical lines, the aim being to increase the efficiency of the propellers for the particular ship for which they were intended. As to the use of machines for finishing, that was made difficult by the variable pitch. This might vary not only along but across the blade. It was only possible to use a simple type of planing machine when the pitch was true. It is hoped that in the near future it may be possible to develop machines capable of dealing with all the special features and high degree of accuracy associated with modern design. With regard to failures, he was pleased to say that they occurred very rarely through any metallurgical fault. The amount of metal chipped off in the dressing gave a pretty good idea whether the metal was sound and clean. He did not claim that they never got dirty castings, particularly in blades which had a big drop. The failures that occurred were generally due to damage by contact with a dock wall or floating wreckage.

Mr. M. H. Curnow asked if the chipping was done because they could not get the propellers moulded to the correct shape. Could not the blades be so moulded that they got nearer the correct pitch and so obviated the chipping?

Mr. Newson replied that they would like, of course, to produce castings which did not require chipping, but he had not yet heard of anyone who had been able to cut out chipping altogether. They had to work to such fine limits of thickness and pitch that a reasonable allowance must be made for dressing.

Mr. W. T. Laverton said he would like to know if it was the practice to cast a form of beading round the edge of the propeller in order to have ample metal to chip away, and so to form a very fine edge when balancing the propeller. Had the lecturer at any time experienced difficulty owing to residual sea water in a propeller blade requiring to be repaired? When burning, whether burning a pre-cast tip, or casting and burning on at the same time, had difficulty been experienced in cracking either on the new tip or the tip of the old blade somewhere in the vicinity of the burning. Would that be likely to occur more frequently with manganese-bronze propellers, or when Turbadium metal was used?

Mr. Newson said reference had been made to the large amount of work that had gone into the business he represented. For himself, he thought a great deal of credit was due to the workmen engaged on the job. It was moulding in its highest form and a great deal of manual skill was required. It might look simple, but a great deal of experience lay behind the methods used. A propeller was not cast with any beading on the edge, but there was always a little trimming allowance to ensure that they got a perfectly good edge. In repairing propeller blades that had been in service he could not recall that trouble had ever been experienced through the presence of sea water. They always ground the part carefully to make sure that cracks did not extend further than they imagined. After grinding and warming up the propeller, before they attempted to put a burn on, he did not think there would be any remains of sea water. Cracking when burning-on very rarely occurred with ordinary manganese-bronze, but Turbadium was liable to develop cracks, except in expert hands. The crack appeared at some little distance from the burning.

Mr. G. M. Callaghan, referring to manganese-bronze, said his experience was that with this metal it was necessary to run it down twice to get the best results. It would be interesting to know why this was necessary.

Mr. Newson replied that it should not be necessary to run down new metal twice. He agreed that it was a decided advantage to run it down and ingot it the first time, but after that there should not be any difficulty. When an alloy was first made, the temperature of the molten mass was considerably higher than bronze would be heated to when melting it for a casting. When they cast it into ingot form, they probably got rid of any dissolved gas. The solubility of the different gases in copper and alloys was rather high at high temperatures, but fell almost to zero when the metal reached its freezing point. When they re-melted, they did not go up to the temperature reached in making the alloy, and no gas entered.

Mr. W. J. Flavell said Mr. Newson did not explain how they vented the blades—whether they used risers or how they managed it.

Mr. Newson said the moulds were not treated in the same way as ordinary moulds. In all cases they had to depend upon the metal displacing the air upward in the mould, through the open head.

The Chairman closed the discussion by expressing hearty thanks to the lecturer, which he acknowledged.

The chairman mentioned that at the annual meeting, on April 12, there would be a short Paper competition. There were to be two prizes.

Nickel Cast Iron for Sewage Disposal Plants

Worthy to be numbered amongst the important engineering developments of recent years, though less spectacular than many, is the progress which has been made in the treatment and disposal of sewage. More efficient processes and better design of equipment have contributed not a little to the more effective use of waste products, to the health of the community and to the pockets of the ratepayers. It is probably a special consideration for the last, which has hitherto prevented the sewage works engineer from progressing so rapidly with his fight against one of his most powerful foes—that of corrosion—as perhaps he would like. Quite rightly he has had to balance the cost of immunity—or practical immunity—from corrosion with the benefits to be obtained, and in consequence he has had to put up with breakdowns and failures which, though irritating and sometimes costly, were not sufficiently serious as to warrant the large expense of corrosion-resisting materials.

The progressive rusting and eventual destruction of ordinary cast iron and steel had to be tolerated simply because the alternative materials were initially more costly, although in practice it could in most cases be proved that their long life made their use economical.

That state of affairs, happily, no longer exists. There is now at the disposal of the engineer a material which is moderate in price, easily available, and whose resistance to corrosion is far and away greater than that of the cheap materials hitherto employed.

This material, known as "Ni-Resist," or by other special names given by individual manufacturers, is available in the form of the various castings required by the sewage engineer. It consists essentially of an alloy of cast iron with nickel and copper, generally also with chromium. Nickel is usually present in the amount of from 12 to 16 per cent., copper 6 to 8 per cent., and chromium 1.5 to 4 per cent. In appearance the alloy is similar to that of a fine-grained grey cast iron. Its strength is similar to that of good cast iron, but it is many times tougher and more resistant to shock. It is machinable and its hardness can be varied at will by controlling the composition, especially with regard to chromium.

Its most important feature, however, is its resistance to corrosive attack, and the accompanying table clearly demonstrates its superiority to ordinary cast iron when in contact with certain well-known corrosive media.

Comparative Rates of Corrosion.

Reagent.	Austenitic cast iron.	Ordinary cast iron.
5 per cent. sulphuric acid cold	1	475
10 per cent. sulphuric acid at 100 deg. C.	1	195
78 per cent. sulphuric acid at 100 deg. C.	1	1.95
5 per cent. hydrochloric acid ..	1	185
25 per cent. acetic acid.. ..	1	400
Salt spray	1	2.9
Sea water	1	5.0

The sewage works engineer, however, will be more interested in the results of tests made under conditions more closely resembling those with which he is specially concerned. Specimens of "Ni-Resist," exposed along with other materials to corrosion in four test locations in an American sewage disposal plant, provided results which are of outstanding interest. It was found, in a test covering a period of 279 days that in the very worst location the rate of corrosion of "Ni-Resist" was equivalent to less than 0.002 in. penetration per year. Its resistance, in practically every case, was many times greater than that of ordinary cast iron, and was even superior to that of copper.

A further interesting property of "Ni-Resist," demonstrated by these tests, was its ability to resist the development of what are sometimes described as "tuberculous growths." This type of growth was very marked on the ordinary cast iron specimen, and occurred to some extent on the steel specimens. It was entirely absent, however, from those made from "Ni-Resist."

The use of "Ni-Resist" in sewage works is still in an early stage, but as its properties become more widely known it will undoubtedly find many uses in places where a moderately priced, cast material—more durable than ordinary cast iron or steel—is required, or where it is necessary to avoid the effects of excessive rusting or tuberculation, which might interfere with the proper functioning of equipment.—*The Nickel Bulletin.*

Publication Received

A.S.T.M. Standards on Refractory Materials. Published by the American Society for Testing Materials, 260, South Broad Street, Philadelphia, Pa. Price $1.

In addition to all of the 21 specifications, test methods and definitions standardised by the American Society for Testing Materials through the work of its Committee C-8 on Refractories, this publication includes the "Manual on Interpretation of Refractory Test Data," detailed information on the standard samples of type refractory materials and reports of extensive industrial surveys showing the service conditions of refractories in outstanding consuming industries. The specifications cover clay firebrick for various uses, refractories for the construction of incinerators, ground fireclay, and quicklime and hydrated lime for the manufacture of silica brick.

Included in the standard methods of testing which are given are the following:—Porosity and volume change; particle size of ground materials; panel test for resistance to thermal and structural spalling; permanent linear change; test under load at high temperature; softening point; high-temperature heat insulation and chemical analysis of refractory materials. Accurate investigation of refractory materials is difficult unless competent methods are used to analyse and report the groups of data developed. The "Manual on Refractory Test Data," which is given, evaluates the methods of interpretation. First issued in 1932, the current manual is extensively revised and simplified. To help to maintain accuracy in the chemical methods of analysis, a series of standard samples of type refractory materials has been developed in co-operation with the National Bureau of Standards and a large number of laboratories. The composition of these samples is given in tabular form.

It has been essential to have adequate information on the conditions under which refractories are used in manufacturing processes. Comprehensive surveys have been made of such conditions in outstanding consuming industries, including the following:—Open-hearth practice, malleable-iron industry, copper industry, lead industry, by-product coke ovens. These reports should be of much interest to those concerned with refractory materials.

Messrs. A. Arnold & Company, stop-watch manufacturers, of 122, St. John Street, who have just removed to larger premises, situated at 19, Clerkenwell Road, London, E.C.1, have sent us along a sample of their lowest-priced stop watches. As its cost is so small, it is eminently suited for placing in the hands of apprentices and students for making engineering and metallurgical tests. The watch we have received is an extremely reliable timekeeper.

Radiography of Welding Defects

Report No. 290 of the materials sub-committee of the Verein deutscher Eisenhüttenleute by W. Tofaute, published in the "Archiv für das Eisenhüttenwesen," deals with the experimental interpretation of welding defects in radiographs and their effect on the physical and mechanical properties of the weld. To establish the connection between radiographic details of welds and their physical properties in the case of welds containing serious defects produced artificially, the author examined arc-welded sheets, 12 and 30 mm., in thickness. It was found that pores in the weld cause a marked diminution in the elongation, notched-bar value and bending angle, while the tensile strength is reduced only half as much as the elongation. The yield point gave no indication of the quality of a weld, as in the tests not the yield point of the weld, but that of the surrounding material, is measured. The notched-bar value could only be estimated from a radiograph when the shock-resisting value of a good weld was not below a certain limit, *e.g.*, 8 mkg. per sq. cm. Determination of the bending angle from the radiographs also failed if defects were located in the root or neutral fibre of the weld. As regards the effects of various types of defects, it was found that lack of bonding about the neutral zone had the most marked influence on the quality of a weld, while porous zones reduced the mechanical and physical properties of welds only half as much as bonding defects.

The Use of Sodium Carbonate in Iron and Steel Works

(*Concluded from page* 235)

about 20 per cent. of the sulphur can be expected. This presupposed a lime content of about 28 per cent. in the slag.

Sodium carbonate had no effect on phosphorus in cast iron.

Several speakers had asked questions about the rate at which soda slag separates from the metal, and the length of time required for skimming. There was no doubt at all that the slag came to the surface almost immediately tapping ceased.

The small globules of fluid slag sometimes observed after the thickened sodium carbonate had been raked off were not rising up through the metal, but were forming on its surface, round the sides of the ladle, and were due to very slight action on the refractory lining. A little parting sand thrown on the surface of the metal would form an effective dam to prevent any fluid globules going into the mould.

The relationship between the percentage of scrap charged to the cupola and the occurrence of shrinkage defects was considered to be due to the introduction of oxides with scrap. Sodium carbonate would be of the greatest value in enabling more scrap to be used, as it removed entrained oxides, and thoroughly degasified the metal by agitation.

Exhibition of Work

Mr. Henry Gardner, works manager of Messrs. Glenfield & Kennedy, Limited, formally opened the exhibition of work done by the students of the evening continuation classes in the technical school, Kilmarnock. In the course of an interesting address Mr. Gardner made reference to his own connection with the technical school as a pupil when it first opened in 1909 and to the opportunities now afforded for the acquisition of knowledge. A section which was new to the exhibition was the work done by students in a course for moulders, and a number of castings made by them were on view. The practical part of this course, which has been conducted by Mr. R. D. Lawrie, foundry manager to Messrs. Glenfield & Kennedy has by the kindness of the firm been performed in the light foundry at Glenfield works.

XUM

Company Meeting Report.

General Refractories Limited, Sheffield

(MANUFACTURERS OF HEAT RESISTING AND INSULATING MATERIALS)

ANNUAL GENERAL MEETING

MR. FRANK S. RUSSELL'S REVIEW

A REMARKABLE YEAR—DIVIDEND INCREASED TO 12½%

The thirty-fifth annual general meeting of General Refractories, Limited, was held at Sheffield on Monday, April 1.

Mr. Frank S. Russell (chairman and managing director) presided, supported by the other directors, Sir Ronald Matthews, J.P., Mr. Roland A. Kirkby and Mr. George Senior.

The Chairman said that the company had had a truly remarkable year, during which all previous records had been left far behind.

The year had strengthened the position in every way, and the company had been better able than ever to serve those who used refractories in their daily work and depended upon their reliability. More and more had the large users of refractories, the great iron and steel makers, copper smelters, gas, glass, coke and cement makers, turned to the company for supplies, and each acquirement of a subsidiary made the general position stronger.

The staff had worked with the same untiring zeal as before, and he wished specially to thank and congratulate the foreign representatives.

The Progress Report

Since they last met a progress report had been circulated and covered operations during the first half of the year. It mentioned that sales for that period had broken all previous records. He would add that the second half of the year was still better and that the sales for the full year were 33 per cent. higher than those of 1933.

The working profit for the year was £42,672, the second half being better than the first.

Acquisitions and Mergers

Since the issue of the progress report a controlling interest in the Meltham Silica Brick Works, which specialised in gas and coke-oven refractories, had been acquired with very promising results, and the holding in other subsidiaries had been strengthened. Arrangements for extensions to enable Meltham to meet the increased volume of business had been made.

The assets of the executors of Charles Bramall had been purchased and included extensive resources of raw materials.

The Armitage works was nearing the end of its re-equipment programme and had shown excellent results.

The works of George Turnbull & Company, Limited, were being rapidly re-equipped to cope with the demand, which was greater than they could handle.

The works of N. B. Allen & Company, Limited, were being re-equipped.

The sand-washing plant at Levenseat had been completed and was in operation, and the sand quarries of Coolee, Limited, had shown excellent results. A complete new brickmaking press unit at Worksop had been officially opened by the Mayor and was in daily operation, the opportunity being taken to invite the whole of the sales staff.

Large volumes of business had followed as a result of the publicity gained and the interest created in the products of this unique plant—the only one of its kind in Europe.

It had, as anticipated, enabled the company to secure heavy contracts which would otherwise have gone abroad.

Fused Refractories

The progress report mentioned a new development. This referred to the introduction of an entirely novel series of refractory bricks and cements made from materials which had been previously fused in the almost unbelievably intense heat of the electric arc—a heat far greater than any refractory materials were called upon to withstand in actual service.

Exceedingly encouraging results had already been secured and it might be that here was a new departure that might have quite revolutionary results. The company had secured special rights with regard to these pre-fused refractories, and was continuing to pursue the subject enthusiastically.

Diatomite

Another fresh development was the exploitation of a new and practically inexhaustible deposit of diatomite (in which the company had secured exceptional rights extending over a long period of years), a form of silica, very light in weight, which, by resisting the passage of heat through it, acted as an insulator to furnaces and other containers of heat—keeping out the cold and keeping in the heat so effectively that its use actually reduced fuel bills by 25 per cent. to 33 per cent. The insulating value of this particular deposit was second to none in the world and was unquestionably far above the average.

The company's Ambergate works were being converted into a factory for the manufacture of diatomite insulating goods, and profitable results were expected.

A New Company to be Formed

There was a vast field for the exploitation of diatomite quite outside their own sphere of refractories insulation. He referred more particularly to its use in the production of plaster boards and partition slabs, which at one and the same time (1) insulated rooms against the entry or loss of heat (keeping them cool in summer and warm in winter), (2) prevented the passage of sound (thus equally excluding the cry of the neighbour's baby and preventing our wireless from waking him up) and (3) were entirely immune to the action of heat, and rather tended to put fires out than to encourage them. The use of boards and slabs made from this particular deposit would provide the community with the blessing of house and room walls which were soundproof, fire-resisting and heat-insulating—a real boon to all.

Considerable demand from builders of flats in particular, in all parts of the world, was anticipated, and members would be interested to know that arrangements had already been made for the formation of an independent public company to be known as International Diatomite Company, Limited, and that their company would benefit considerably from the flotation, because of their part ownership of the equity.

This company would exploit the diatomite also for filtration, filling, polishing, steam insulation, cement working and many purposes other than those for which their own company was developing it, and shareholders would shortly be given a preferential opportunity of subscribing for its shares.

High Quality of British Refractories

Mr. Russell referred to the continued improvements in the quality of British refractories, and said it was perfectly safe to say there was now none better in the whole world, and less than no reason why users of refractories should make purchases abroad.

Their countrymen could supply all their needs with promptitude, of high quality, and certainly at prices no higher than those charged by the foreigner.

He ventured to impress this upon those who directed our great British steel industry under protection, and pointed out that favouring tariffs had not been extended to the refractories industry and that the position laid upon steelmakers a positive duty to purchase their refractories from their own countrymen, who shared their conditions and their traditions, and lived (and might die) under the same flag. (Applause.)

The Silver Jubilee

Mr. Russell mentioned the happy festivities in which we should all join in May, and announced that the whole of the company's employees would receive a full day's holiday, and in cases where that would mean loss of wages to them, a full day's pay also. (Applause.)

Publicity

The company continued to take full advantage of Press and other publicity, and had found that the exhibition of films of the processes was useful and had formed a special department to deal with it. They proposed to develop further in this direction, as they were certain it brought them contacts and advantages almost unobtainable by any other means.

Export Trade

He said that the overseas branch had progressed by leaps and bounds during the year, and now constituted a very substantial part of the business. Heavy contracts for export were on hand at the moment, and shareholders might be certain that the work of this department would be energetically pursued.

A New Branch Works in Belgium

Anticipating a devaluation of Belgian currency, the board had purchased a suitable refractories works in Belgium and had for some time been equipping it for the manufacture of high-grade refractories of all kinds. Production would commence next month and very substantial benefits were practically certain to accrue, as the enterprise had received a very warm welcome from their customers abroad, and it put them in such a position that devaluation and protection were advantageous rather than the contrary. A subsidiary company had been formed, and, as a large part of the expenditure had been already met, a financial return was looked for in 1935.

New Head Offices

He announced that the company had outgrown their present offices, which were not their own property and neither well situated nor convenient. They had, therefore, purchased, at a very reasonable price, a suitable and convenient building where they would have room to expand, and would get the benefit of working in a better light and purer air. He was certain this move would be of benefit to the company, as its annual cost would be no more than the present cramped quarters and the health of the staff would certainly be better and their work more efficient.

Future Prospects

"And now," said Mr. Russell, "you will ask, what of the present and the future?" For the "present," he could answer that a quarter of the year had now gone, that its sales were at least 15 per cent. above the high figures of last year, and that March sales were about 25 per cent. higher than those of the previous March.

The steel industry still remained their greatest customer.

The more British steel the more British refractories, and, in his opinion, the prospects of the steel industry were for 1935 brighter than they had ever been.

It had the sympathy of the Government, which had protected it by tariffs, which had only just recently been still further advanced, and it seemed certain that no devalution of Continental currencies would be allowed to prejudice this vital industry.

And now we had a new factor, precipitated by recent events abroad, for which this country of ours had no responsibility, and would never be called upon to take any blame. He referred to the obvious recommencement of the "Armaments Race." Lovers of peace as we were, and much as we deplored the position which had resulted from the continual rattling of the sabre which nearly deafened those who looked and listened across the Channel, facts must be faced, and it was admitted on all hands that a defenceless Great Britain was more of a menace than one fully armed, and ready to act in the future, as in the past, on the side of right and justice.

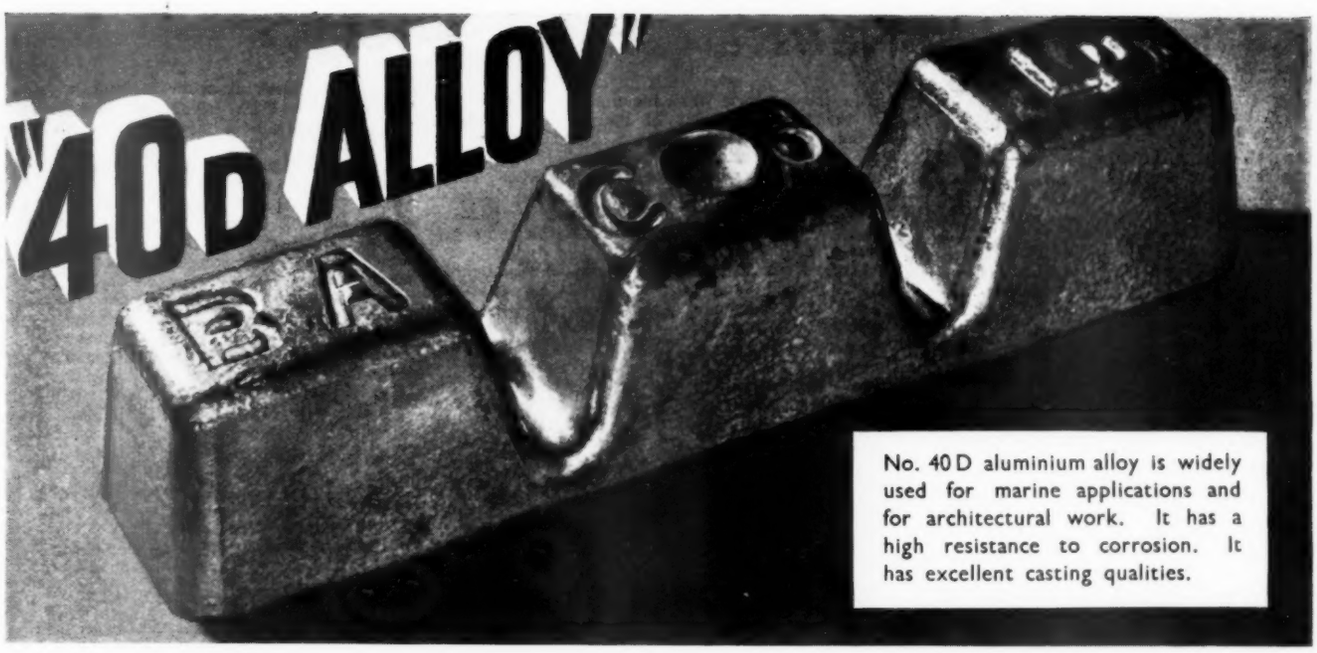
Our rulers had, therefore, wisely decided that our arms must be strengthened without delay, and the consequent activity could not be other than beneficial to the steel trade, and through it to the British refractories industry, without which we should be truly at the mercy of any foe that chose to attack us. And here, again, was another strong argument in favour of the exclusive purchase of refractories made at home.

Review of Accounts

Proceeding to review the accounts, Mr. Russell said that the balance-sheet had in every respect been vitally strengthened during the year 1934. The new capital had been utilised to redeem all charges ranking in front of the shares, so that they now had the clear simple position that the whole of the capital was in shares, and in one class of shares only.

Apart from the saving in interest charges, the new capital had not yet had time to yield them a direct return, but they had earned a much larger profit than last year, and were able to pay on the whole of the increased capital a larger dividend than the year before, without having had the benefit of the earning power of that capital. He ventured to say that the policy of mergers and acquisitions had been fully justified, and assured the shareholders it was intended to continue it. He mentioned that as the

(*Concluded on page* 244)



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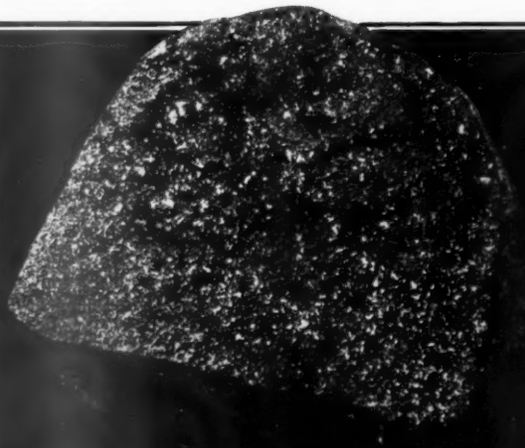

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PIG IRON

This Week's News in Brief

Trade Talk

Messrs. Vickers-Armstrongs, Limited, are to give each employee at their Barrow works a day's holiday with pay on May 6, on the occasion of the King's Silver Jubilee. Approximately 11,000 people are employed at the works.

The Clydeside Constructional Company, Limited, Bridge of Weir, has secured the contract from the Wigton Rural District Council for the provision and laying of 37 miles of water main. Spun pipes entirely are to be used.

The following Scottish firms have agreed to give their workers a day's holiday with full pay in celebration of the King's Silver Jubilee on May 6:—Messrs. R. & A. Main, Limited, London and Falkirk, Smith & Wellstood, Bonnybridge, and Mitchell Russell & Company, Bonnybridge.

An interesting order for a motor passenger launch has been placed by the L.M.S. Railway Company with Messrs. William Denny Bros., Limited, Dumbarton. The vessel will be for service between Millport and Fairlie, and, although small, will be of interesting design, and will probably be the forerunner of other passenger motor launches for the Clyde service.

Messrs. Hurst Nelson & Company, Limited, Flemington, Motherwell, have booked further orders, including ten fuel-oil and six petrol-carrying tank wagons, to be shipped to Rhodesia. These wagons are considerably more expensive than ordinary freight-carrying wagons. It is understood that the firm have a number of valuable inquiries, including some from China.

The staff of the Suffolk Iron Foundry held a very successful dinner last Friday. Mr. L. J. Tibbenham occupied the chair, supported by Mr. J. M. Prentice, secretary; Mr. R. Marland, general manager; and Mr. F. Tibbenham, foundry manager. After a programme of entertainment, Mr. Manning Prentice proposed the toast of "The Suffolk Iron Foundry," coupled with the name of Mr. L. J. Tibbenham. Mr. Tibbenham replied.

A five-day sale of the shipbuilding and engineering plant at the Tyne Iron Shipyard, Willington Quay, Dobson's Yard, Walker, and the Amble Shipyard, was held last week at Messrs. Sir W. G. Armstrong, Whitworth & Company's Low Walker Shipyard, which has been purchased, along with the three yards mentioned, by National Shipbuilders Security, Limited. The Low Walker Yard is not to go out of existence, but is to be retained to be available if required.

The orders placed in Great Britain by Soviet trading organisations in February of the current year amounted to £1,121,282, as compared with £902,863, for the same month last year. The total value of the orders placed in the first two months was £1,827,690, as compared with £1,318,649 for the corresponding period in 1934, an increase of 38.6 per cent. The principal goods purchased last month were:—Machinery and equipment, £530,295; ferrous alloys and steel, £36,977; non-ferrous metals, £213,017.

The directors of Imperial Chemical Industries, Limited, have decided to submit to the shareholders proposals for the simplification of the capital structure of the company, by the amalgamation of the two classes of ordinary shares and deferred shares into one class of ordinary shares, on the basis of four fully-paid deferred shares of 10s. each being converted into one fully-paid ordinary share of £1 each, with effect from January 1, 1935. These proposals will be considered at extraordinary general meetings to be held following the annual meeting, which will take place on May 1.

A proposal to reduce and reorganise the capital of the Atlas Steel Foundry & Engineering Company, Limited, Armadale, West Lothian, is to be made at an extraordinary general meeting in Glasgow on April 10. The present capital is £75,000 in shares of £1 each. Under the scheme 10s. of each share will be cancelled, thus eliminating capital which has been lost or is unrepresented by available assets. Afterwards each two shares of 10s. will be consolidated into one £1 share. It is also proposed to restore the capital to the former amount by the creation of 37,500 new shares of £1 each.

Sir Walter Kent, President of the Institution of Production Engineers, spoke at the annual dinner of the Yorkshire Section of the Institution in Leeds recently. He said that production engineering in its present form was undoubtedly a young branch of the profession, but in its importance to the nation it was second to none, and the Institution of Production Engineers could claim a position equal to any among the engineering societies. Their membership was now almost 1,200, and they intended to establish as many branches as possible, so as to put the Institution within reach of all production engineers.

Having for 22 years held the appointment under Royal Warrant as "ironfounders to his Majesty," the Carron Company, as members of the Royal Warrant Holders' Association, have given for the drawing-room of the "King's House" a cast-iron dog-grate, modern Georgian in style, with recess, side panels and hearth, manufactured to the design of Mr. C. Beresford Marshall, L.R.I.B.A., the architect for the house. The fireplace is finished in satin armour bright, and is an excellent example of the ironfounder's art. The company have also presented a Carron bath in lustrous porcelain enamel with panels and appropriate fittings, together with lavatory suite.

Contracts Open

Pocklington.—Cast and spun-iron pipes, valves, pumps, etc., for the Rural District Council. Mr. J. H. Haiste, Middleton Chambers, Lowgate, Hull.

London, April 23.—Electrically-driven centrifugal pumping plant, including pipes, castings, sluice valves, etc., for the Singapore Municipality. The Department of Overseas Trade. (Reference G.Y. 14,958.)

Taunton, April 9.—160 12-in. by 12-ft. ordinary cast-iron pipes to British standard specification for class C pipes, coated inside and outside, for the Town Council. Mr. W. H. Bailey, town clerk, Municipal Buildings, Taunton.

North Sunderland, April 8.—For the Belford Rural District Council:—Providing, laying, jointing and testing about one mile of 3-in., 4-in., 5-in. and 6-in. cast or spun iron spigot and socket pipes, with specials, valves, and fire hydrants, etc. Messrs. Taylor & Wallin, 1, Saville Place, Newcastle-upon-Tyne. (Fee £5 deposit, returnable.)

Newport Pagnell, April 8.—For the Urban District Council:—Providing, laying, jointing and testing about 1¼ miles of 3-in., 4-in., 5-in. and 6-in. cast or spun iron spigot and socket water mains, with specials and valves; erection of a pumping station and a concrete tank, etc. Messrs. Taylor & Wallin, 1, Saville Place, Newcastle-upon-Tyne. (Fee £5 deposit, returnable.)

Ely, April 30.—Contracts C—provision and laying of 26,300 yds. of 8-in. and 1,300 yds. of 6-in. dia. spun-iron pipes; D—provision and laying of 14,500 yds. of 3-in. and 6,300 yds. of 2-in. dia. cast-iron pipes, together with sluice valves, hydrants and ancillary work; E—provision and laying of 10,600 yds. of 3-in. and 6,200 yds. of 2-in. dia. cast-iron pipes, together with sluice valves, hydrants and ancillary work, for the Rural District Council. Messrs. Silcock & Simpson, 25, Victoria Street, Westminster, S.W.1, and 10, Park Row, Leeds, 1. (Fee £5 for each separate tender.)

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

International Diatomite Company, Limited, Russell House, Adelphi, W.C.2.—Capital £1,000. To acquire mines and mining rights; to search for and deal in silica, gypsum, alabaster, brick-earth, minerals, etc. Directors: F. S. Russell and Sir Ronald W. Matthews.

Belling & Company, Limited.—Capital £100,000. To take over the goodwill of the business of manufacturing electrical engineers, etc., carried on at Bridge Works, Southbury Road, Enfield, as "Belling & Company." Permanent governing director: C. R. Belling.

Haslam Foundry & Engineering Company, Limited. Capital £40,000. To acquire the goodwill of the foundry and refrigerating business carried on by, and certain of the assets and liabilities of, Haslam & Newton, Limited. Directors: S. R. Beale, E. W. Elliott, and P. C. Cooper-Parry. 102, Friar Gate, Derby.

Personal

Mr. and Mrs. Andrew Gilfillan, of Church Street, Radnor Park, Clydebank, who are both over 80 years of age, have just celebrated their diamond wedding. Mr. Gilfillan has been an employee of the Singer Manufacturing Company, Kilbowie, for over 45 years.

Mr. G. Albert Thomson, managing director of Brown Bros. & Company, Limited, Rosebank Ironworks, Edinburgh, has given £10,000 to Edinburgh University for the purpose of establishing a commercial laboratory in the university. The gift was made after consultation with the President and other prominent members of Edinburgh Chamber of Commerce, of which Mr. Thomson was President in 1921 and 1922. It will enable the most approved methods of training students for a commerce degree to be introduced, and will provide for the immediate requirements in staff and equipment for such a laboratory.

Wills

Simpson, H. W., of Dewsbury, iron and steel merchant	£9,691
Sanders, George, of Weston-super-Mare, brassfounder, late of Messrs. Thomas Sanders, Limited, Birmingham ...	£35,649

Obituary

Mr. William Forrester, who, in conjunction with his brother, Mr. James Forrester, carried on for a long period the business of the Larbert Brass Works, died recently.

Mr. Robert K. Caldwell, retired engineer and works manager of Messrs. Pott, Cassels & Williamson's works, Motherwell, died last week. Mr. Caldwell was over 70 years of age.

Company Reports

Vickers-Armstrongs, Limited.—Profit, £724,541; brought in, £77,995; tax, £148,737; fees, £2,450; depreciation, £215,821; preference dividend, £330,916; carried forward, £104,613.

Cammell Laird & Company, Limited.—Net profit, £29,173; brought in, £3,005; interest at the rate of 2½ per cent. on the first and third mortgage debenture stocks, £29,612; carried forward, £2,565.

Vickers, Limited.—Net trading profit, £970,352; income tax, debenture interest and other expenses, £357,091; preference dividends, £418,190; brought in, £224,041; dividend of 6 per cent., less tax, on the ordinary share capital, £190,889; carried forward, £228,222.

General Refractories, Limited.—Profit, after interest charges and income tax, £35,042; brought in, £10,400; to bad debts reserve, £1,000; to depreciation reserve, £3,000; to income-tax and general reserve, £5,000; final dividend of 7½ per cent., making 12½ per cent. for the year; carried forward, £15,265.

Imperial Chemical Industries, Limited.—Gross income for 1934, £7,965,038; to central obsolescence and depreciation fund, £1,000,000; income tax, £615,931; net income, £6,349,107; brought in, £566,139; preference dividend, £1,588,897; interim dividend of 2½ per cent. on the ordinary shares, £1,093,916; to general reserve, £1,000,000; final dividend on the ordinary shares of 5½ per cent., making 8 per cent. for the year, and a dividend on the deferred shares of 2 per cent., £5,306,795; carried forward, £608,451.

Barium Compounds in Electric-Furnace Practice

According to L. C. Hewitt, in a Paper which he presented to the Philadelphia International Foundrymen's Congress, it has been learned lately that 2 per cent. of a mixture of barium oxide and barium carbonate, added to the ganister as used for the bottom and lining of electric direct-arc furnaces, has worked out advantageously in the instance tried. Sintering is reported to be aided and the tendency toward silicon pick-up by the metal reduced. It also is reported that barium compounds, when added to the bath, as in the case of the indirect-arc furnace, not only benefit the metal but have a beneficial effect upon the roof as well, due to "dusting" of the roof by the barium as it is introduced into the furnace.

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COMPARISONS ARE — SOMETIMES USEFUL

PARISH'S SILICA
× 60

TYPICAL SEA SAND
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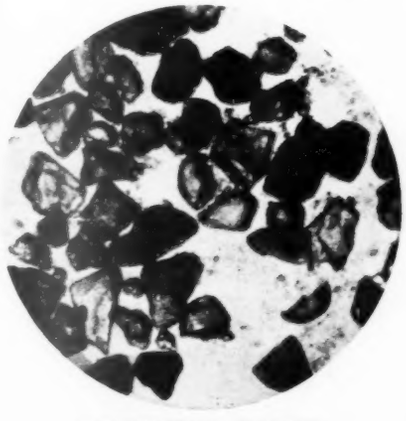

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Parish's Silica provides the vital factors for ideal core production—

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MECHANISED SCREENING

TOGETHER THEY GIVE YOU

ECONOMY WITH ANY BINDER
PERFECT VENTING
99.33% SILICA 0.3% ALUMINA

An eminent Metallurgical Authority says

"This sand is an excellently graded Silica Sand. The grains as seen under the microscope are uniform in size and shape and free from undesirable inclusions."

Deliveries from our rail sidings to yours or by SEA or ROAD

ASK FOR THIS LITTLE ENVELOPE

Also Erith Loam marketed in Five Grades:—
MILD, YELLOW, MEDIUM, STRONG and EXTRA STRONG

WRITE FOR PARTICULARS FROM:—

J. PARISH & Co.
ERITH, KENT

ESTABLISHED 1805

SAMPLE OF
PARISH'S
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SAND
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Raw Material Markets

Business in the iron and steel markets, which has recently been inclined to wait on political developments, has not yet resumed a free course. No sooner had the markets taken on a more cheerful tone following the announcement of increased steel duties than the Belgian Government decided to devaluate the belga. This step may have further consequences, but for the moment it seems that the Belgian steel exporter is nominally in a much stronger position in the export markets.

Domestic trade in this country is generally on a satisfactory level, and there are indications that the spring buying movement is getting into its stride.

Pig-Iron

MIDDLESBROUGH.—The home demand for Cleveland iron is again broadening out, and expectations are that a period of brisk business lies ahead. Delivery specifications from Scotland have shown a marked improvement. During the quarter just ended the demand was substantially equal to the output, and unsold stocks at the works have therefore remained low. A very large proportion of the local production of pig-iron is going into direct consumption in the steelworks, but for the surplus output of foundry and forge qualities available for the open market the fixed home prices are based on No. 3 Cleveland G.M.B. at 67s. 6d. per ton delivered Middlesbrough, 69s. 6d. delivered North-East Coast, 67s. 3d. delivered Falkirk, and 70s. 3d. delivered Glasgow.

The improved prospects in the steel trade are reflected in the better demand for East Coast hematite. There is a strong demand from Sheffield and the Midlands, and deliveries have been resumed to South Wales. There has been no change in prices.

LANCASHIRE.—Trading in pig-iron remains rather quiet, which is not unnatural in view of the stability of the price level. Several replacement contracts have been negotiated, however, and more business of that nature should come out this month. The market is quite steady, with Staffordshire, Derbyshire and Lancashire brands of No. 3 foundry iron equal to Derbyshire, all on offer for delivery to Lancashire users on the basis of 74s. per ton. Northamptonshire brands are quoted at 72s. 6d. per ton, with Derbyshire forge iron offered at 69s. to approved users, Scottish foundry at around 82s. 6d., West Coast hematite at around 78s. 6d., and East Coast at from 75s. to 76s. per ton, according to quality.

MIDLANDS.—The spring demand for iron is now making itself felt, but is not yet up to expectations. Most of the ironfounders have contracted for supplies up to the end of April, and new business has therefore been limited. At the meeting of the Central Pig-Iron Producers' Association last week, no change in prices was made. The reaffirmed prices delivered this area for ordinary Midland foundry irons are 67s. 6d. for Northants No. 3 and 71s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, delivered Birmingham and Black Country stations—to large consumers under certain conditions a graduated rebate is allowed. Prices of irons for the general engineering and jobbing trades vary considerably, according to tonnage and quality. Medium-phosphorus irons are quoted at 72s. to 80s., low-phosphorus 85s. to 87s. 6d., and Scottish at 85s., while special refined irons for Diesel-engine and similar work range from £5 7s. 6d. to £7 per ton, delivered this district.

SCOTLAND.—Dealing in Scottish pig-iron remains principally of a hand-to-mouth description. No. 3 foundry continues to be quoted at 70s. per ton f.o.t. furnaces, with 2s. 6d. extra for No. 1. Activity in the light-castings trade continues very satisfactory, and prospects are equally good. No. 3 Cleveland pig remains at 67s. 3d. f.o.t. Falkirk and 70s. 3d. f.o.t. Glasgow, with 1s. 3d. extra for other English irons.

Coke

Conditions remain unchanged in the cupola-coke market. Quotations for delivery in the South Staffordshire area are unaltered, as follow:—Best Durham coke, 36s. to 40s.; other grades, down to 34s.; Welsh coke, 34s. to 43s. 6d.; Scottish coke, about 40s. per ton.

Steel

More active conditions have developed in the steel markets under the influence of the higher import duties, although the full effects of these are not likely to be seen for some weeks, states the official report of the London Iron and Steel Exchange. Large tonnages of Continental material which were contracted for previous to the raising of the duties have still to be delivered, and it will take a little time for the market to absorb these imports. The semi-finished steel department has again become more active as a result of the alteration in the import duty, and a considerable volume of business has been diverted to the British manufacturers. Deliveries against existing contracts are upon a heavy scale, and this branch of the industry appears to be assured of a spell of activity. Business in finished steel has been somewhat irregular, but the position generally seems to be improving and large tonnages of steel are being consumed by the home industries. Export business is quiet.

Scrap

Scrap iron is generally a firm market. In the Cleveland district there is a ready demand for all available supplies of heavy metal, prices averaging 55s. per ton for good machinery quality and 53s. per ton for ordinary foundry cast iron. There is a regular demand for cast-iron scrap in the Midlands, where heavy machinery metal in handy pieces is offered at 55s. to 56s., good heavy at 50s., and clean light cast iron at 47s. 6d. The corresponding grades are in very limited demand in South Wales, where heavy cast iron is quoted at 50s. to 52s. 6d. and machinery grade in foundry sizes at 52s. 6d. to 55s.

Metals

Copper.—At the end of last week an official communiqué was issued in New York as to the progress made with the restriction talks. The statement first emphasised that the conference was between the principal producers of copper *outside* the United States, as the latter remains virtually a closed market, and that it was called to consider the serious situation arising out of the heavy surplus of copper supplies over demand in the foreign markets. The producers participating represented an aggregate current production of about 750,000 tons per year. Complete agreement was reached on all matters discussed. A curtailment amounting to 240,000 tons of copper per year from current production is to be made effective by June 1. There will be no pooling of sales or fixing of prices, but endeavours will be made to avoid wide price fluctuations. The agreement ends in July, 1938. The disposal of copper exports from the United States is not provided for in the official document, but it is understood that a "gentlemen's agreement" has been arrived at whereby they are restricted to 8,000 tons per month. Such discretion was apparently necessary to avoid breaking the United States anti-trust laws.

The confirmation of what was felt to be a foregone conclusion further strengthened the confidence of the market, and quotations rose further.

Daily quotations:—

Cash.—Thursday, £30 3s. 9d. to £30 5s.; Friday, £30 12s. 6d. to £30 15s.; Monday, £30 15s. to £30 16s. 3d.; Tuesday, £30 6s. 3d. to £30 7s. 6d.; Wednesday, £30 5s. to £30 6s. 3d.

Three Months.—Thursday, £30 11s. 3d. to £30 12s. 6d.; Friday, £31 to £31 2s. 6d.; Monday, £31 2s. 6d. to £31 3s. 9d.; Tuesday, £30 15s. to £30 16s. 3d.; Wednesday, £30 13s. 9d. to £30 15s.

Tin.—Dealing in tin has been of a dull nature during the past few days, and Continental business has been disturbed by the fluctuating exchanges.

The March statistics have now been published. According to Mr. W. H. Gartsen, total visible supplies at the end of March were 18,064 tons, or 41 tons less than a month before. Total deliveries in March were 8,090 tons (U.K. 858 tons), as against 6,756 tons (U.K. 921 tons) in February.

Market fluctuations:—

Cash.—Thursday, £216 to £216 10s.; Friday, £215 15s. to £216 5s.; Monday, £216 5s. to £216 10s.; Tuesday, £216 15s. to £217; Wednesday, £217 10s. to £218.

Three Months.—Thursday, £212 17s. 6d. to £213; Friday, £212 5s. to £212 10s.; Monday, £212 10s. to £212 15s.; Tuesday, £213 10s. to £213 15s.; Wednesday, £214 15s. to £215 5s.

Spelter.—Although prices are still fairly firm, a hesitant tone has developed in the market since the rejection of the import-duty plan.

Official quotations:—

Ordinary.—Thursday, £13; Friday, £12 17s. 6d.; Monday, £12 5s.; Tuesday, £12; Wednesday, £12 3s. 9d.

Lead.—It is reported that the scheme, referred to in these columns last week, for the amendment of the present import-duty position so as to allow dealings to take place on the basis of "duty for sellers' account," has been rejected by the Import Duties Advisory Committee. This came as a distinct surprise to the market, and quotations have fallen sharply. It was expected that the scheme, which had the support of the principal producers and consumers and the London Metal Exchange, would also be applied to the spelter market.

Day-to-day prices:—

Soft Foreign (Prompt).—Thursday, £12; Friday, £12; Monday, £11 12s. 6d.; Tuesday, £11 6s. 3d.; Wednesday, £11 13s. 9d.

General Refractories Limited, Sheffield

(*Concluded from page* 240)

market price of the company's shares had, during the year 1934, varied from 9s. 7½d. to 23s. 3d. the new capital had been issued at varying premiums, the result being the accumulation of a fund of £50,046, which carried no dividend and on which no interest had to be paid, and which had been used to strengthen the balance sheet. He said that, despite the great increase in turnover, the trade accounts payable were only £376 higher than they were the previous year, and the trade bills were less by £78. The reserve accounts showed a figure more than six times that of last year, and the credit balance was (because of appropriations being deducted first on this occasion) actually over £10,000 higher than last year.

After reviewing other items which had been improved and strengthened, he mentioned that the accounts receivable were higher by no less than £34,837, a reflection of the increased business done during the year, that cash was higher by £14,290 and stock by £10,323, the latter mainly because larger stocks of finished goods were now being kept on hand, with the result that it was possible for orders of almost any size to be executed on the day of receipt.

The balance of assets over liabilities was £56,158 higher, and the number of shareholders had increased by over 900 to 1,409, the company now controlling 41 works, mines or quarries, as against 33 last year.

The expenditure on railway carriage and wagon hire had been no less than £73,246 (as against £56,759), a figure which entitled the company to consideration from the railway companies whenever they were in the market for refractories.

The directors had given careful consideration to the question of a dividend, and while they were well aware that the profits earned, and the position generally, might be held to justify a larger distribution than the one recommended, they had in mind the cost of the re-equipment of subsidiaries which was now taking place, and the further expansion of trade which was being experienced this year and which had to be financed.

They had also in mind the promising negotiations they were at present conducting with a view to a further merger of a very important and interesting character, and they believed that their conservative policy with regard to the dividend would appeal to the bulk of the company's shareholders.

They had every reason to hope that it would be possible about the end of July next to pay an interim dividend to coincide with a progress report covering the first six months of 1935.

The Board had been pleased during the year to be able to pay an interim dividend of 5 per cent. (against 2 per cent.), and they now asked for its confirmation and the adoption of their recommendation of a final dividend of 7½ per cent., less income tax (making 12½ per cent. for the year).

The Chairman then formally moved the adoption of the report and accounts and called upon Sir Ronald Matthews to second the motion, which was carried unanimously.

Mr. Kirkby was re-elected to the Board, the auditors were reappointed, and the proceedings terminated with a vote of thanks to the directors, the staff and the Chairman.

50 different kinds!

Steel Moulding Sands, Iron and Brass Moulding Sands of every type (there are over 50 different grades from which to choose) are produced by us at centres situated throughout England and Scotland. With these facilities, the founder is able to gain considerable advantage by having sand delivered at low railway rates.

From Yorkshire Steel Moulding Sand to Minimum Core Sand, we produce grades coarse and fine in texture, heavily and lightly bonded.

Also, advice is willingly given on sand problems.

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London 7361 Temple Bar.

Head Office :
Genefax House, Sheffield.
London Office :
Russell House, Adelphi, W.C.2.

Telegrams :
"Genefax," Sheffield.
"Genefax," Rand, London.

RAW MATERIALS—PRICE LIST

(Wednesday, April 3, 1935)

COPPER

	£	s.	d.
Standard cash	30	5	0
Three months	30	13	9
Electrolytic	33	15	0
Tough	32	5	0
Best selected	32	15	0
Sheets	60	0	0
India	44	0	0
Wire bars	34	0	0
Ingot bars	34	0	0
H.C. wire rods	36	15	0
Off. av. cash, March	28	11	0⅝
Do., 3 mths., March	28	18	2½
Do., Sttlmnt., March	28	10	11⅞
Do., Electro, March	31	16	10½
Do., B.S., March	31	9	2
Do., wire bars, March	32	1	6¼
Solid drawn tubes			9¾d.
Brazed tubes			9¾d.
Wire			6¼d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8¼d.
Rods, extd. or rlld.	4¼d.
Sheets to 10 w.g.	7⅛d.
Wire	7d.
Rolled metal	6⅞d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN

	£	s.	d.
Standard cash	217	10	0
Three months	214	15	0
English	217	15	0
Bars	219	15	0
Straits	223	10	0
Australian (nom.)			—
Eastern	220	10	0
Banca	223	10	0
Off. av. cash, March	215	19	5½
Do., 3 mths., March	211	17	1⅝
Do., Sttlmt., March	215	18	9⅞

SPELTER

	£	s.	d.
Ordinary	12	3	9
Remelted	13	0	0
Hard	10	5	0
Electro 99.9	14	15	0
English	13	5	0
India	11	15	0
Zinc dust	17	0	0
Zinc ashes	3	0	0
Off. aver., March	12	3	5⅞
Aver. spot, March	12	1	10⅞

LEAD

	£	s.	d.
Soft foreign ppt.	11	13	9
Empire (nom.)	12	16	3
English	13	15	0
Off. average, March	11	1	11 13/14
Average spot, March	11	0	2⅝

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	22	5	0
Do., V.M. ex-whse.	22	17	6
Rods	27	0	0

ANTIMONY

	£	s.	d.
English	82	0	0 to 83 0 0
Chinese, ex-whse., (nom.)	69	0	0
Crude			—

QUICKSILVER

	£	s.	d.		£	s.	d.
Quicksilver	11	7	6	to	11	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	8 17 6
45/50%	12 15 0
75%	17 17 6
Ferro-vanadium—	
35/50	12/8 lb. Ve.
Ferro-molybdenum—	
70/75% carbon-free	4/6 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£15 15 0
Ferro-tungsten—	
80/85%	3/- lb.
Tungsten metal powder—	
98/99%	3/3 lb.
Ferro-chrome—	
2/4% car.	31 10 0
4/6% car.	21 15 0
6/8% car.	21 10 0
8/10% car.	21 10 0
Ferro-chrome—	
Max. 2% car.	34 0 0
Max. 1% car.	36 5 0
Max. 0.70% car.	37 5 0
70% carbon-free	9¾d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£184 0 0
Ferro-cobalt, 98/99%	5/- to 5/6 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d
Finished bars, 18% tungsten	2s. 9d

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 3/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

South Wales—	£	s.	d.		£	s.	d.
Heavy steel	2	15	0	to	2	16	0
Bundled shrngs.					2	7	6
Mixed iron and steel	2	10	0	to	2	11	6
Heavy cast iron	2	10	0	to	2	12	6
Good machinery	2	12	6	to	2	15	0
Cleveland—							
Heavy steel	2	11	6	to	2	12	6
Steel turnings					1	15	0
Cast-iron borings					1	5	0
Heavy cast iron					2	13	0
Heavy machinery					2	15	0
Midlands—							
Light cast-iron scrap					2	7	6
Heavy wrought iron					3	0	0
Steel turnings, f.o.r.					1	14	0
Scotland—							
Heavy steel					2	10	0
Ordinary cast iron					2	11	6
Engineers' turnings					1	19	0
Cast-iron borings					1	18	9
Wr'ght-iron piling					2	16	3
Heavy machinery					2	16	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	26	0	0
Brass	17	10	0
Lead (less usual draft)	11	0	0
Tea lead	8	0	0
Zinc	9	0	0
New aluminium cuttings	66	0	0
Braziery copper	22	0	0
Gunmetal	24	0	0
Hollow pewter	152	0	0
Shaped black pewter	105	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	69/-
Hematite M/Nos.	68/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	81/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	82/6
Clyde, No. 3	82/6
Monkland, No. 3	82/6
Summerlee, No. 3	82/6
Eglinton, No. 3	82/6
Gartsherrie, No. 3	82/6
Shotts, No. 3	82/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	9	12	6	to	9	15	0
Nut and bolt iron	7	10	0	to	8	0	0
Hoops	10	10	0	and up.			
Marked bars (Staffs) f.o.t.				12	0	0	
Gas strip	10	10	0	and up.			
Bolts and nuts, ¾ in. × 4 in.				14	2	6	and up.
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	9	5	0	to	9	7	6
Chequer plts.				10	7	6	
Angles				8	7	6	
Tees				9	7	6	
Joists				8	15	0	
Rounds and squares, 3 in. to 5½ in.				9	7	6	
Rounds under 3 in. to ⅜ in. (Untested)				8	12	0	
Flats—8 in. wide and over				8	12	6	
,, under 8 in. and over 5 in.				8	17	6	
Rails, heavy	8	5	0	to	8	10	0
Fishplates	12	5	0	to	12	10	0
Hoops (Staffs)				9	7	0	
Black sheets, 24g. (4-t. lots)				10	10	0	
Galv. cor. shts. (,,)				13	0	0	
Galv. flat shts. (,,)				13	10	0	
Galv. fencing wire, 8g. plain				14	10	0	
Billets, soft	5	10	0	and up.			
Billets, hard	6	17	6	to	7	2	6
Sheet bars	5	0	0	to	5	7	6
Tin bars	5	2	6	to	5	7	6

PHOSPHOR BRONZE

	Per lb. basis.
Strip	9d
Sheet to 10 w.g.	10d.
Wire	11½d.
Rods	10½d.
Tubes	13d.
Castings	12d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	18.00
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	27.00
Sheet bars	28.00
Wire rods	38.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	1.80
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.10
Wire nails	2.60
Plain wire	2.30
Barbed wire, galv.	3.00
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	19/- to 20/-
Durham foundry	19/- to 22/-
,, furnace	16/6 to 17/9
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	18/2 to 19/2
,,	28×20 ,,	36/4 to 38/4
,,	20×10 ,,	26/- to 26/3
,,	18¾×14 ,,	18/6 to 18/9
C.W.	20×14 ,,	15/6 to 16/6
,,	28×20 ,,	33/- to 33/6
,,	20×10 ,,	23/- to 24/-
,,	18¾×14 ,,	16/- to 17/-

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6	0	0	to	£7	0	0
Bars-hammered, basis	£16	0	0	to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0	to	£16	0	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£30	0	0	to	£31	0	0
Faggot steel	£18	0	0	to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0	to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£ s. d.	
Mar. 28 ..	30 3 9	inc. 1/3
„ 29 ..	30 12 6	„ 8/9
Apr. 1 ..	30 15 0	„ 2/6
„ 2 ..	30 6 3	dec. 8/9
„ 3 ..	30 5 0	„ 1/3

Electrolytic Copper

	£ s. d.	
Mar. 28 ..	33 5 0	No change
„ 29 ..	33 15 0	inc. 10/-
Apr. 1 ..	34 0 0	„ 5/-
„ 2 ..	33 10 0	dec. 10/-
„ 3 ..	33 15 0	inc. 5/-

Standard Tin (cash)

	£ s. d.	
Mar. 28 ..	216 0 0	dec. 5/-
„ 29 ..	215 15 0	„ 5/-
Apr. 1 ..	216 5 0	inc. 10/-
„ 2 ..	216 15 0	„ 10/-
„ 3 ..	217 10 0	„ 15/-

Tin (English ingots)

	£ s. d.	
Mar. 28 ..	216 10 0	dec. 10/-
„ 29 ..	216 10 0	No change
Apr. 1 ..	216 10 0	„ „
„ 2 ..	217 0 0	inc. 10/-
„ 3 ..	217 15 0	„ 15/-

Spelter (ordinary)

	£ s. d.	
Mar. 28 ..	13 0 0	dec. 5/-
„ 29 ..	12 17 6	„ 2/6
Apr. 1 ..	12 5 0	„ 12/6
„ 2 ..	12 0 0	„ 5/-
„ 3 ..	12 3 9	inc. 3/9

Spelter (Electro, 99.9 per cent.)

	£ s. d.	
Mar. 28 ..	15 10 0	dec. 5/-
„ 29 ..	15 7 6	„ 2/6
Apr. 1 ..	14 17 6	„ 10/-
„ 2 ..	14 12 6	„ 5/-
„ 3 ..	14 15 0	inc. 2/6

Zinc Sheets (English)

	£ s. d.	
Mar. 28 ..	22 5 0	dec. 5/-
„ 29 ..	22 5 0	No change
Apr. 1 ..	22 5 0	„ „
„ 2 ..	22 5 0	„ „
„ 3 ..	22 5 0	„ „

Lead (English)

	£ s. d.	
Mar. 28 ..	14 0 0	dec. 5/-
„ 29 ..	14 0 0	No change
Apr. 1 ..	13 15 0	dec. 5/-
„ 2 ..	13 10 0	„ 5/-
„ 3 ..	13 15 0	inc. 5/-

AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1899	2 13 0	2 14 0	2 14 0	2 14 0	3 0 0	3 2 0	3 13 0	3 16 6	3 15 0	3 16 6	3 16 6	4 0 0	3 6 2½
1900	4 0 0	4 0 0	4 0 0	4 1 6	4 1 0	3 18 0	3 13 6	3 12 6	3 11 0	3 11 0	3 9 6	3 8 0	3 15 5
1901	2 13 6	2 17 0	2 15 0	2 15 0	2 14 0	2 13 9	2 13 6	2 13 6	2 14 6	2 13 0	2 12 6	2 16 6	2 14 3½
1902	2 17 6	2 17 6	2 15 6	2 16 9	2 16 6	2 16 6	2 16 6	2 17 0	2 18 6	2 18 6	2 17 6	2 17 6	2 17 1½
1903	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1904	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1905	2 13 0	2 13 0	2 11 6	2 12 6	2 12 0	2 12 0	2 12 3	2 12 3	2 14 0	2 16 6	3 0 0	3 0 6	2 14 1
1906	3 2 0	3 5 0	3 3 0	3 0 6	2 17 0	2 18 6	2 18 0	2 16 6	2 19 0	3 0 6	3 1 6	3 7 0	3 0 8½
1907	3 7 0	3 7 0	3 5 0	3 2 0	3 4 0	3 8 0	3 6 0	3 5 0	3 4 0	3 2 6	3 1 0	2 18 6	3 4 2
1908	2 15 0	2 14 6	2 14 6	2 15 6	2 14 0	2 13 0	2 13 0	2 11 6	2 12 6	2 13 0	2 12	2 12 6	2 13 5½
1909	2 13 0	2 12 6	2 11 6	2 12 0	2 12 6	2 12 6	2 12 0	2 12 6	2 14 6	2 15 0	2 14 6	2 14 0	2 13 0½
1910	2 13 9	2 14 0	2 14 0	2 14 4	2 15 0	2 15 0	2 14 9	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0	2 14 7½
1911	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 15 0	2 15 0	2 15 0	2 15 8½
1912	2 17 4½	2 17 6	2 17 6	3 1 1½	3 2 6	3 3 9	3 6 3	3 7 6	3 10 10½	3 12 6	3 13 3½	3 14 6	3 5 4
1913	3 15 7	3 15 0	3 11 10½	3 11 4½	3 10 2½	3 6 10½	3 4 2½	3 2 9	3 1 9	3 1 0	2 19 3	2 17 2½	3 6 5
1914	2 17 2½	2 18 0	2 18 0	2 17 0	2 17 0	2 16 7½	2 16 0	3 2 10	3 1 0	2 19 9½	2 16 11½	2 18 1½	3 6 2
1915	3 1 2	3 3 11	3 5 9	3 18 8½	3 13 7	3 14 1	3 15 0	3 13 3	3 12 0½	3 11 1	3 14 0	4 3 3	3 12 2½
1916	4 4 6½	4 11 6	4 11 6½	4 7 6	4 7 6	4 7 6	4 10 0	4 12 10	4 12 6	4 12 6	4 12 6	4 12 6	4 8 6½
1917	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1918	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1919	4 12 6	4 12 6	4 12 6	4 12 6	7 2 6	7 5 0	8 8 5	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	7 3 10
1920	9 13 9	10 0 0	10 5 3	10 15 3	11 10 0	12 2 6	12 5 0	13 1 3	14 7 6	14 5 0	14 5 0	14 5 0	12 12 1½
1921	12 11 8	10 8 9	9 2 6	8 2 0	8 0 0	8 0 0	8 0 0	8 1 8	7 4 0	6 7 6	5 7 6	4 1(10	8 0 2
1922	5 5 0	4 17 6	4 15 0	4 15 0	4 12 6	4 12 6	4 12 6	4 12 6	4 11 3	4 10 0	4 10 0	4 10 0	4 13 7½
1923	4 12 8½	5 0 2	6 2 6	6 8 7½	6 2 5	5 11 9	5 9 1½	5 4 0	5 0 0	5 0 9	5 0 7	5 2 9	5 7 11½
1924	5 3 0	5 3 0	5 3 0	5 3 0	5 2 10	5 1 3	4 17 11	4 15 6	4 13 6	4 10 1½	4 10 0	4 10 3	4 17 9½
1925	4 10 0	4 9 0	4 6 9	4 5 2½	4 3 0	4 0 1½	4 17 1½	3 15 7½	3 14 3½	3 13 4½	3 13 4½	3 13 2½	4 1 9
1926	3 14 9	3 15 3	3 15 6	3 15 3½	3 17 6	4 5 9	4 16 9	*	*	*	*	4 12 6	4 0 1½
1927	4 13 9½	4 13 3	4 11 1½	4 9 4½	4 6 1½	3 19 1½	3 16 1½	3 15 6	3 13 4½	3 13 4½	3 14 0	3 13 6½	4 1 6½
1928	3 13 2½	3 12 3½	3 12 3	3 12 3	3 11 6	3 10 0	3 8 3	3 7 8½	3 7 6	3 7 9½	3 8 3	3 7 6	3 9 10½
1929	3 8 3½	3 10 4½	3 10 10½	3 11 0	3 11 2½	3 12 0	3 12 4½	3 14 6	3 15 1½	3 17 0	3 17 0	3 17 0	3 13 1½
1930	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 15 0	3 12 0	3 12 0	3 12 0	3 10 1½	3 9 6	3 14 4½
1931	3 9 6	3 9 6	3 9 6	3 9 6	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 10
1932	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1933	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1934	3 7 0	3 9 6	3 13 2½	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 14 0	3 12 11½
1935	3 14 0	3 14 0	3 14 0	—	—	—	—	—	—	—	—	—	—

* No prices available during strike period.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK LIMPET

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

COREMAKER wants job as Working Foreman or Chargehand. Iron and Ali. Oil-sand jackets and jobbing. Previous firms, Kent's, Luton; Rodney, Deptford.—35, The Drive, Feltham.

FOUNDRY Manager requires position. Capable full control. General engineering and railway work, mass production, complete estimating from blue-print to finished castings. Extensive experience melting units, shop design and general lay-out; iron, steel and non-ferrous and patternshop.—Box 216, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

HEAD Foreman or Foundry Manager wants similar position; iron castings up to 60 tons each in weight. Fully conversant with an output of 5,000 tons per year.—Box 222, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman seeks position, London district; 20 years' experience with high-class work in ferrous or non-ferrous pressure castings; accustomed to modern plant; good organiser.—Box 220, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

WANTED, for a large European firm of Engineers in India, a Senior Estimator and Designer in the Bridge and Structural Department. Applicants should be of good address and education and possess practical workshop experience and sound knowledge of design of steel bridges and structures. Preference will be given to those holding B.Sc. (London) or equivalent degrees. Age between 25 and 30. First agreement will be for a period of 5 years. —Applications, with copies of references and details of experience, stating age and whether married or single, by letter to "E. & D.," c/o W. Abbott, Limited, 32, Eastcheap, London, E.C.3.

WANTED, experienced Working Foreman to take charge of small foundry 50 miles from London. Must have knowledge of mixtures.—Box 218, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

WANTED, for iron and steel works in North Lincolnshire, a practical Combustion Engineer, accustomed to gas-fired reheating furnaces control; age 30 to 35.—Apply, stating age, particulars of experience and salary required, to Box 224, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

ESTABLISHED Firm of Ironfounders have vacancy for Sales Representative with first-class connections in underground cast-iron pipes, etc., and light castings generally. Territory: Scotland and the North of England. State age, experience, and salary expected.—Address, "Iron," Wm. Porteous & Company, Advertising Agents, Glasgow.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of The Foundry Trade Journal.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

PRACTICAL Foundryman with sound experience of mixing of aluminium and special alloys desires position. (260)

SITUATIONS VACANT AND WANTED.—*Contd.*

LIGHT-CASTINGS Trade.—Position required as Foreman or Assistant. Experience with first-class light-castings firms, also malleable experience. Technical training. (256)

FOREMAN or Assistant Foreman. Position required by young moulder with supervisory experience in iron and steel works plant and general engineering castings. Understands cupola practice and is technically trained. Position with prospects and opportunities of experience desired. (257)

STEEL-FOUNDRY Foreman requires position. Experience in alloy-steel castings. Heavy shipping, valve, locomotive and general engineering. Estimate all foundry operations. (258)

IRONFOUNDRY Foreman seeks re-engagement. Thoroughly experienced in light castings on most up-to-date plant, including mechanisation. Sound technical training; would take full charge or any situation offering prospects. (259)

AUCTION

By Order of the Receivers for the Debenture Holders.

Re Wm. Hammond & Company (Syston), Limited.

WITH VACANT POSSESSION.

SYSTON, LEICESTER,

with Siding to the Main Line Junction Station, 4½ miles from the progressive city of Leicester.

The highly important Freehold Industrial Property,

"THE SYSTON FOUNDRY,"

comprising Two Blocks of substantial Foundries, Shops and Offices, with a Ground Floor Area of 35,000 Sq. Ft., together with other Factory Premises, extensive Yards and Land and Twelve Cottages, covering in all a spacious site of 7½ Acres, suitable for conversion for other industrial purposes.

WARNER, SHEPPARD & WADE will offer the above Property for SALE by AUCTION at their Mart at Leicester on TUESDAY, APRIL 9, at 3 o'clock, in Seven Lots.

Detailed Particulars and Plans from the Auctioneers, 16 and 18, Halford Street, Leicester.

TENDER

METROPOLITAN WATER BOARD.

TENDERS FOR THE SUPPLY OF STORES, Etc.

THE Metropolitan Water Board invite Tenders for the supply of the undermentioned Stores and Services for periods of 6 and 12 months commencing June 1, 1935:—

Contract No.

1.—Bricks, Firebricks, Cement, etc.
8.—Iron and Steel.
9.—Bolts and Nuts, Screws, Files, Shovels, Steam Tubes, etc.
12.—Fuel Oil, Oil (Lubricating), Kerosene, Motor Spirit, Greases, etc
19.—Iron, Brass, Gun-metal and other Castings.
20.—G.M. Stopcocks and Ferrules, Outlets and Caps for Fire Hydrants.
22.—Timber.
23.—Maintenance of Weighing Machines.

Tenders must be submitted on the official forms, which may be obtained on and after Monday, March 25, 1935, from the Chief Engineer, by personal application at the Offices of the Board (Room 155) or upon forwarding a stamped addressed envelope (large).

Applicants should refer to the number of the Contract for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed in the manner indicated in the Form of Tender, must be delivered at the Offices of the Board (Room 122) not later than 11 a.m. on Monday, April 15, 1935.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery Avenue, E.C.1.
March 19, 1935.

GANISTER

Purchase your supplies from actual Producers with over 50 years' reputation

Scientifically treated, specially ground Ganister for Cupolas, Iron & Steel Works, &c.

SPECIAL LADLE GANISTER

TRIAL BAGS FREE
Quotations on application

The ASTBURY SILICA CO.
CONGLETON, Cheshire
Est. 50 Years

MACHINERY

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. Davies & Son, West Gorton, Manchester.

SANDBLAST PLANTS

Room Plants, sizes 12 ft. x 12 ft., 12 ft. x 9 ft. and 6 ft. x 6 ft., made up in cast-iron sections.

Barrel Plants, 30 in. dia. x 36 in. long and 30 in. dia. x 18 in. long rotary barrels.

Cabinet Plants, in sizes 4 ft. x 4 ft. x 4 ft., 36-in. dia. and 30-in. dia. operators' cabinets.

Most of the above by Tilghman and complete with Air Compressors.

HAND MOULDING MACHINES

By Adaptable, Pridmore, Darling & Sellars, etc.; Squeezers by Utard (unused), Samuelson and Britannia, also Farwell Universal Type.

Ladles, Grinding Machines, Exhaust Fans, Blowers, Air Compressors and 500 Electric Motors and Dynamos.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.

CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

'Phone: 287 SLOUGH

MOULDING MACHINES

406 OSBORN jolt rollover.
18"×36" TABOR rollover shockless (portable).
40"×30" TABOR rollover shockless.
TWO BRITANNIA No. 1 jolters.
HAND Machines taken in part payment for above or exchanged.
EXTENDED PAYMENTS ARRANGED.

SANDBLAST PLANTS

12' × 9' Tilghman sandblast room, built of cast iron plates, complete with 400 cu. ft. Tilghman air compressor and all accessories.
T.B. 4 Tilghman sandblast barrel plant, complete. Size of barrel 60" × 40".
T.B. 1 Tilghman sandblast barrel.
Small Tilghman rotary table sandblast.

BUY FROM ME AND SAVE MONEY!

Alex. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH